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1. Scientific and technical reports of the National Aeronautics and Space Administration and its contractors.
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3. Scientific and technical articles prepared by employees of NASA and its contractors that appear in the learned and technical journals.

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Scientific and Technical Information Division
National Aeronautics and Space Administration

Table of Contents

Volume 2 Number 13 / July 8, 1964

Abstracts in the journal are grouped under the following categories: PAGE

01 GENERAL
Includes administration and management; space law and related legal matters; legislative hearings and documents; and symposia or conferences of a broad or a general nature 1547

02 AERODYNAMICS OF BODIES, COMBINATIONS, AND INTERNAL FLOW
Includes aerodynamics of channels, cowls, ducts, ejectors, nozzles, etc. *For related information*: 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 11 Fluid Mechanics. 1551

03 AERODYNAMICS OF WINGS, ROTORS, AND CONTROL SURFACES
Includes ailerons; airfoil sections; cascades; fans; flaps; propellers; rotors; slats; spoilers; etc. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 11 Fluid Mechanics. 1553

04 AIRCRAFT
Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc., and specific types of complete aircraft (e.g., Ground Effects Machines, Flexible Wings, STOL, and VTOL); flight tests; operating problems; safety devices; and stability and control. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 30 Space Vehicles. 1553

05 ASTRONOMY AND ASTROPHYSICS
Includes celestial mechanics; and radioastronomy. *For related information see*: 12 Geophysics; and 29 Space Sciences. 1555

06 AUXILIARY SYSTEMS
Includes fuel cells and solar cells; gas turbines; hydraulic, pneumatic and electrical control systems and actuators; and inverters. *For primary propulsion systems see*: 27 Propulsion. *For related information see*: 08 Communications; 09 Electronics; 10 Facilities, Research and Support; 15 Instrumentation and Photography; and 22 Navigation and Guidance. 1556

07 CHEMISTRY
Includes chemical analysis and identification (e.g., spectroscopy); chemical engineering; chemical properties of materials; and synthesis. *For related information see*: 18 Materials, Metallic; 19 Materials, Nonmetallic; and 26 Propellants and Combustion. 1561

08 COMMUNICATIONS
Includes communications equipment and techniques; noise; radio and communications blackout; telemetry; tracking; and wave propagation. *For tracking stations see*: 10 Facilities, Research and Support. *For related information see*: 06 Auxiliary Systems; 09 Electronics; 15 Instrumentation and Photography; and 22 Navigation and Guidance. 1568

09 ELECTRONICS
Includes circuits and circuit theory; electronic components (e.g., tunnel diodes, transistors, and tubes); and feedback and control theory. *For related information see*: 06 Auxiliary Systems; 08 Communications; 15 Instrumentation and Photography; 22 Navigation and Guidance; and 25 Physics, Solid-State. **1572**

10 FACILITIES, RESEARCH AND SUPPORT
Includes airports; lunar and planetary bases; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands and wind tunnels); test ranges; and tracking stations. *For related information see*: 06 Auxiliary Systems. **1577**

11 FLUID MECHANICS
Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; 13 Heat Transfer and Thermodynamics; and 24 Physics, Plasma. **1580**

12 GEOPHYSICS
Includes auroral phenomena; upper atmosphere studies; oceanography; cartography; geodesy; and geomagnetism. *For Van Allen belts see*: 28 Space Radiation. *For related information see*: 05 Astronomy and Astrophysics; 21 Meteorology; and 29 Space Sciences. **1582**

13 HEAT TRANSFER AND THERMODYNAMICS
Includes ablation; cooling; heating; and other thermal effects. *For aerothermodynamics see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 03 Aerodynamics of Wings, Rotors, and Control Surfaces. *For combustion see*: 26 Propellants and Combustion. *For related information see*: 11 Fluid Mechanics. . . **1587**

14 HUMAN BEHAVIOR
Includes crew training and evaluation; piloting; and psychological factors. *For simulators see*: 10 Facilities, Research and Support. *For related information see*: 16 Life Sciences. **1590**

15 INSTRUMENTATION AND PHOTOGRAPHY
Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gauges; sensors and transducers; and telescopes and cameras. *For related information see*: 06 Auxiliary Systems; 08 Communications; 09 Electronics; and 22 Navigation and Guidance. **1591**

16 LIFE SCIENCES
Includes biology; exobiology; physiology; medicine; life support systems; radiation effects on biological systems; and space sickness. *For related information see*: 14 Human Behavior; and 28 Space Radiation. **1598**

17 MACHINE ELEMENTS AND PROCESSES
Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control; and materials fabrication, handling and inspection. *For related information see*: 06 Auxiliary Systems. **1603**

18 MATERIALS, METALLIC
Includes cermets; mechanical and physical properties of alloys and metals; and metallurgy. *For related information see*: 07 Chemistry; 17 Machine Elements and Processes; 19 Materials, Nonmetallic; 33 Stresses and Loads; and 34 Structural Design. **1609**

19 MATERIALS, NONMETALLIC
Includes mechanical and physical properties of nonmetals (e.g., plastics). *For related information see*: 07 Chemistry; 17 Machine Elements and Processes; 18 Materials, Metallic; 33 Stresses and Loads; and 34 Structural Design. **1615**

20 MATHEMATICS
Includes calculation methods and theory; computers; data processing; and numerical analysis. *For related information see*: 08 Communications; 09 Electronics; 10 Facilities, Research and Support; and 22 Navigation and Guidance. **1618**

21 METEOROLOGY
Includes climatology; weather forecasting; and lower atmosphere studies. *For related information see*: 05 Astronomy and Astrophysics; 12 Geophysics; and 29 Space Sciences. **1624**

22 NAVIGATION AND GUIDANCE
Includes autopilots; star tracking; inertial platforms; and air traffic control. *For related information see*: 06 Auxiliary Systems; 08 Communications; 09 Electronics; 10 Facilities, Research and Support; 15 Instrumentation and Photography; 20 Mathematics; and 29 Space Sciences. **1630**

23 PHYSICS, GENERAL
Includes acoustics; cryogenics; and optics. *For astrophysics see*: 05 Astronomy and Astrophysics. *For related information see*: 12 Geophysics; 24 Physics, Plasma; 25 Physics, Solid-State; and 29 Space Sciences. **1631**

24 PHYSICS, PLASMA
Includes fusion; and magnetohydrodynamics. *For related information see*: 05 Astronomy and Astrophysics; 23 Physics, General; and 25 Physics, Solid-State. **1641**

25 PHYSICS, SOLID-STATE
Includes semiconductor theory; and masers. *For related information see*: 09 Electronics; 23 Physics, General; and 24 Physics, Plasma. **1647**

26 PROPELLANTS AND COMBUSTION
Includes fuels; igniters; and oxidizers. *For related information see*: 07 Chemistry; and 27 Propulsion. **1653**

27 PROPULSION
Includes airbreathing, electric, liquid, nuclear, and solid propulsion. *For related information see*: 04 Aircraft; 06 Auxiliary Systems; 26 Propellants and Combustion; and 30 Space Vehicles. **1654**

28 SPACE RADIATION
Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. *For related information see*: 05 Astronomy and Astrophysics; 16 Life Sciences; and 29 Space Sciences. **1657**

29 SPACE SCIENCES
Includes space chemistry; cosmology; lunar and planetary exploration; and theoretical analysis of orbits and trajectories. *For space biology see*: 16 Life Sciences. *For related information see*: 05 Astronomy and Astrophysics; 12 Geophysics; and 22 Navigation and Guidance. **1658**

30 SPACE VEHICLES
Includes launch vehicle-spacecraft combinations; missile systems; operating problems; safety devices; and stability and control. *For manned space capsules, satellites, and sounding rockets and space probes see*: 32 Space Vehicles (Spacecraft). *For boosters and launch vehicles see*: 31 Space Vehicles (Launch Vehicles). *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance. **1659**

31 SPACE VEHICLES (LAUNCH VEHICLES)

Includes boosters; clustered rockets; and multistage rockets. *For propulsion engines see*: 27 Propulsion. *For manned space capsules, satellites, and sounding rockets and space probes see*: 32 Space Vehicles (Spacecraft). *For launch vehicle-spacecraft combinations see*: 30 Space Vehicles. *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance. . . . . **No Abstracts**

32 SPACE VEHICLES (SPACECRAFT)

Includes manned space capsules; satellites; and sounding rockets and space probes. *For boosters and launch vehicles see*: 31 Space Vehicles (Launch Vehicles). *For launch vehicle-spacecraft combinations see*: 30 Space Vehicles. *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance. **1662**

33 STRESSES AND LOADS

Includes fatigue; vibration; flutter; and structural tests. *For thermal stress see*: 13 Heat Transfer and Thermodynamics. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 34 Structural Design. **1662**

34 STRUCTURAL DESIGN

Includes structural elements; and weight analysis. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 33 Stresses and Loads. **1665**

SUBJECT INDEX **I-1**

CORPORATE SOURCE INDEX **I-65**

PERSONAL AUTHOR INDEX **I-85**

REPORT/ACCESSION NUMBER INDEX **I-117**

ACCESSION/REPORT NUMBER INDEX **I-125**

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Scientific and Technical Aerospace Reports

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of the National Aeronautics and Space Administration

July 8, 1964

01 GENERAL

Includes administration and management; space law and related legal matters; legislative hearings and documents; and symposia or conferences of a broad or general nature.

N64-20154 RAND Corp., Santa Monica, Calif.
SOVIET PHILOSOPHY, SCIENCE AND CYBERNETICS
F. J. Krieger May 1963 25 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3619-PR; AD-405565)

The thematic plan of the Soviet philosophical journal, *Voprosy Filosofii* (Problems of Philosophy) is presented. The journal is composed of the following nine sections: (1) theoretical problems in building communism; (2) dialectical materialism and the philosophical problems of science, logic, and cybernetics; (3) historical materialism; (4) Marxist–Leninist ethics; (5) scientific atheism; (6) aesthetics; (7) criticism of contemporary bourgeois philosophy and sociology; (8) history of philosophy; and (9) criticism and bibliography. R.T.K.

N64-20187 Dayton U., Ohio Research Inst.
ESTABLISHMENT OF A COORDINATE INDEXING RETRIEVAL SYSTEM FOR THE AIR FORCE MATERIALS LABORATORY Final Summary Report, 1 Dec. 1960–30 Nov. 1963
Edward A. Janning Wright-Patterson AFB, Ohio, Res. and Technol. Div., Mar. 1964 76 p refs
(Contract AF 33(616)-7698)
(RTD-TDR-63-4263; AD-428423)

A coordinate indexing system for a library containing over 10,000 documents was established for the Air Force Materials Laboratory. The primary feature of this system is the ability to conduct either manual or computer searches. Manual searches are made using a dual dictionary that has been prepared by the University's NCR-304 computer. A thesaurus of over 18,000 multidisciplinary terms for this system was prepared. This report discusses in detail the indexing of documents using deep indexing with links and roles, the procedure used in editing the generated vocabulary, and the various machine operations used in mechanizing the system. Briefly discussed are various studies made, or in the planning stage, to evaluate several aspects of the system; in particular, an evaluation of the use of links and roles in the retrieval of information. Author

N64-20198 Congress. Senate. Committee on Aeronautical and Space Sciences
NASA AUTHORIZATION FOR FISCAL YEAR 1965. PART I: SCIENTIFIC AND TECHNICAL PROGRAMS
James E. Webb et al Washington, GPO, 1964 272 p Hearings before Comm. on Aeron. and Space Sci., 4 Mar. 1964
(88th Congr., 2d Sess., S. 2446, Pt. 1, Comm. Print)

Presented are hearings held before the Committee on Aeronautical and Space Sciences of the United States Senate on a bill to authorize appropriations to the National Aeronautics and Space Administration for: research and development, construction of facilities, administrative operations, and other purposes. Scientific and technical programs are discussed in general. P.V.E.

N64-20199 Congress. Senate. Committee on Aeronautical and Space Sciences
NASA AUTHORIZATION FOR FISCAL YEAR 1965. PART 2: PROGRAM DETAIL
James E. Webb et al Washington, GPO, 1964 539 p Hearings before Comm. on Aeron. and Space Sci., Mar. 4–6, 9, 16–18, 1964
(88th Congr., 2d Sess., S. 2446, Pt. 2, Comm. Print)

Hearings before the Committee on Aeronautical and Space Sciences of the United States Senate are presented. The hearings were held on a bill to authorize appropriations to the National Aeronautics and Space Administration for: research and development, construction of facilities and administrative operations, and other purposes. Details of the various programs are discussed. P.V.E.

N64-20235 Defense Dept., Washington, D.C. Office of the Director of Defense Research and Engineering
SHOCK, VIBRATION AND ASSOCIATED ENVIRONMENTS, PART III Bulletin No. 33
Naval Res. Lab., Mar. 1964 295 p refs Presented at the 33d Symp. on Shock, Vibration and Assoc. Environ., Washington, 3–5 Dec. 1963
(AD-435514)

CONTENTS:

1. EFFECT OF MOUNTING-VARIABLES ON ACCELEROMETER PERFORMANCE B. Mangolds (RCA) p 1–12 (See N64-20236 13-15)

2. SURFACE FINISH EFFECTS ON VIBRATION TRANSDUCER RESPONSE R. W. Miller (Marine Eng. Lab.) p 13–18 (See N64-20237 13-15)

3. CALIBRATION OF WATER COOLED HIGH TEMPERATURE ACCELEROMETERS W. R. Taylor and C. D. Robbins (LTV) p 19–25 refs (See N64-20238 13-15)

4. A METHOD OF EMBEDDING ACCELEROMETERS IN SOLID PROPELLANT ROCKET MOTORS R. L. Allen and L. R. Flippin (Thiokol Chem. Corp.) p 27–43 (See N64-20239 13-27)

5. CALIBRATORS FOR ACCEPTANCE AND QUALIFICATION TESTING OF VIBRATION MEASURING INSTRUMENTS R. R. Bouche and L. C. Ensor (Endevco Corp.) p 45–55 refs (See N64-20240 13-15)

6. A PEAK SHOCK VELOCITY RECORDER FOR STUDYING TRANSPORTATION HAZARDS M. Gertel (Mitron Res. and Develop. Corp.) p 57–62 (See N64-20241 13-15)

7. THE USE OF STRAIN GAGES TO DETERMINE TRANSIENT LOADS ON A MULTI-DEGREE-OF-FREEDOM ELASTIC STRUCTURES F. R. Mason (Lockheed Missiles and Space Co.) p 63–68 (See N64-20242 13-30)

8. AUTOMATIC ACCELEROMETER CHECK-OUT EQUIPMENT G. M. Heiber and B. Mangolds (RCA) p 69–72 (See N64-20243 13-15)

9. THE CONDENSER MICROPHONE FOR BOUNDARY LAYER NOISE MEASUREMENT W. T. Fiala and J. J. Van Houten (LTV) p 73–78 refs (See N64-20244 13-44)

10. A TEST VEHICLE PROTECTION CIRCUIT E. L. Gardner (Atomics Intern.) p 79–80 (See N64-20245 13-09)

SHOCK TESTING

11. THE DESIGN AND ADVANTAGES OF AN AIR-ACCELERATED IMPACT MECHANICAL SHOCK MACHINE L. F. Thorne (Bendix Corp.) p 81–84 (See N64-20246 13-06)

12. SIMULATING FLIGHT ENVIRONMENT SHOCK ON AN ELECTRODYNAMIC SHAKER G. W. Painter and H. J. Parry (Lockheed-Calif. Co.) p 85–96 refs (See N64-20247 13-10)

13. DYNAMIC MOORING TESTS OF ONE-QUARTER SCALE MODELS OF THE GEMINI AND AGENA SPACECRAFT N. E. Stamm and L. A. Priem (McDonnell Aircraft Corp.) p 97–99 refs (See N64-20248 13-30)

VIBRATION TESTING

14. PROBLEMS AND CONSIDERATIONS IN COMBINING SINE AND RANDOM VIBRATION IN THE ENVIRONMENTAL TEST LABORATORY A. R. Pelletier (RCA) p 101–106 (See N64-20249 13-34)

15. FLEXURE STABILIZATION OF A REACTION VIBRATION MACHINE R. H. Chalmers, Jr. (Navy Electron. Lab.) p 107–108 (See N64-20250 13-10)

16. AN ALTERNATE METHOD OF EXCITER SYSTEM EQUALIZATION D. Scholz (Mc Donnell Aircraft Corp.) p 109–112 (See N64-20251 13-10)

17. CORRELATION OF DAMAGE POTENTIAL OF DWELL AND CYCLING SINUSOIDAL VIBRATION E. Soboleski and J. N. Tait (Naval Air Develop. Center) p 113–123 (See N64-20252 13-33)

18. SIMULATION OF REVERBERANT ACOUSTIC TESTING BY A VIBRATION SHAKER D. U. Noiseux (Bolt, Beranek, and Newman Inc.) p 125–136 refs (See N64-20253 13-10)

COMBINED TEMPERATURE-VIBRATION TESTS

19. COMBINED HIGH TEMPERATURE-VIBRATION TEST TECHNIQUES H. S. Bieniecki and E. Kuhl (Mc Donnell Aircraft Corp.) p 137–140 (See N64-20254 13-33)

20. COMBINING INDUCTION HEATERS WITH EXISTING ENVIRONMENTAL FACILITIES TO CONDUCT TESTS AT RE-ENTRY TEMPERATURES C. D. Robbins and E. L. Mulcahy (LTV) p 141–147 refs (See N64-20255 13-10)

21. THE NEL EXPERIMENTAL VIBRATION TEST STAND FOR USE IN CHAMBERS A. A. Arnold (Navy Electron. Lab.) p 149–151 (See N64-20256 13-10)

22. A TECHNIQUE FOR PERFORMING VIBRATION TESTS AT HIGH TEMPERATURES IN EXCESS OF 3500° F C. F. Hanes and R. W. Fodge (LTV) p 153–158 (See N64-20257 13-10)

VIBRATION TEST SPECIFICATION

23. A PROCEDURE FOR TRANSLATING MEASURED VIBRATION ENVIRONMENT INTO LABORATORY TESTS K. W. Smith (Army Electron. Res. and Develop.) p 159–177 refs (See N64-20258 13-32)

24. MEASUREMENT OF EQUIPMENT VIBRATIONS IN THE FIELD AS A HELP FOR DETERMINING VIBRATION SPECIFICATIONS I. Vigness (Naval Res. Lab.) p 179–181 (See N64-20259 13-33)

25. DETERMINATION OF AN OPTIMUM VIBRATION ACCEPTANCE TEST G. J. Hasslacher, III and H. L. Murray (GE) p 183–188 (See N64-20260 13-33)

26. VIBRATION TESTS, AN ESTIMATE OF RELIABILITY J. L. Rogers (Martin Co.) p 189–194 (See N64-20261 13-17)

STANDARDIZATION OF VIBRATION TESTS

27. SINUSOIDAL VIBRATION TESTING OF NONLINEAR SPACECRAFT STRUCTURES W. F. Bangs (NASA, Goddard Space Flight Center) p 195–201 refs (See N64-20262 13-33)

28. SOME PROBLEM AREAS IN THE INTERPRETATION OF VIBRATION QUALIFICATION TESTS J. E. Wignot and M. D. Lamoree (Lockheed-Calif. Co.) p 203–210 refs (See N64-20263 13-33)

29. TAMING THE GENERAL PURPOSE VIBRATION TEST J. P. Salter (Royal Armament Res. and Develop. Estab.) p 211–217 refs (See N64-20264 13-33)

30. PANEL SESSION—STANDARDIZATION OF VIBRATION TESTS p 219–229

31. COMPARISON OF PREDICTED AND MEASURED VIBRATION ENVIRONMENTS FOR SKYBOLT GUIDANCE EQUIPMENT J. M. Brust and H. Himelblau (Northrop Corp.) p 231–280 refs (See N64-20265 13-22)

N64-20308 Office of Naval Research, London (Gt. Brit.)
SOME ELECTRONICS RESEARCH AT THE ROYAL RADAR ESTABLISHMENT, MALVERN
Glenn H. Keitel 14 Feb. 1964 17 p refs
(ONRL-9-64; AD-438830)

The present status of research in the following areas is summarized: (1) semiconductor physics; (2) infrared and basic material work—particularly, attention to the construction of a tube for the generation of mm-wavelength radiation; (3) cryogenics; (4) theoretical physics and mathematics; (5) electronic circuits; (6) quantum electrons; (7) high-power modulators; (8) applied physics and technical services; (9) radio astronomy; and (10) radio meteorology. I.v.L.

N64-20363 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
TRANSACTIONS OF THE PHYSICS INSTITUTE

D. V. Skobel'tsyn, ed. 21 Mar. 1963 248 p refs Transl. into ENGLISH of Tr. Fiz. Inst., Akad. Nauk SSSR (Moscow), v. X, 1958
(FTD-TT-62-958/1+2; AD-401729)

CONTENTS:

1. IN MEMORIAM S. Z. BELEN'KIY p 1–3
2. CONTRIBUTION TO THE THEORY OF FLOW OF SUPERSONIC GAS PAST A WEDGE S. Z. Belen'kiy p 4–19 refs (See N64-20364 13-02)
3. HYDRODYNAMIC EQUATIONS WITH ACCOUNT OF RADIATION S. Z. Belen'kiy p 20–30 refs (See N64-20365 13-11)
4. PRINCIPLES OF PROTON SYNCHROTRON THEORY M. S. Rabinovich p 31–243 refs (See N64-20366 13-11)

N64-20367 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
NEWS OF THE ACADEMY OF SCIENCES OF THE USSR
22 Apr. 1963 29 p refs Transl. into ENGLISH of selected articles from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow) p 19–23, 106–113
(FTD-TT-63-204/1+2+4; AD-409055)

CONTENTS:

1. THERMOACOUSTICAL INSTABILITY OF A HETEROGENEOUS GAS FLOW K. I. Artamanov and I. G. Krutikova p 1–11 refs (See N64-20368 13-11)
2. NON-STEADY FLUTTER OF PLATES AND SLATED SHELLS IN GAS SHELLS V. V. Bolotin p 12–26 refs (See N64-20369 13-33)

N64-20505* National Aeronautics and Space Administration, Washington, D.C.
REMARKS BY JAMES E. WEBB, ADMINISTRATOR, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, DURING LANGLEY INSPECTION WEEK AT LANGLEY RESEARCH CENTER, HAMPTON, VIRGINIA
James E. Webb 18 May 1964 7 p
Available from the Scientific and Technical Information Div.

According to Mr. Webb, Administrator, National Aeronautics and Space Administration, the Langley Research Center is, in reality, a national resource, typical of the "triangular approach" to the problem areas of aerospace; with industry, universities, and government in-house competence teamed up for close cooperation in enlarging man's ability to operate, vicariously and in person, both in the atmosphere and in space. It is pointed out that the studies being undertaken at Langley are not, in any sense, commitments to flight programs or hardware. They are, rather, feasibility investigations into areas that appear to hold promise for future space missions. Langley capabilities in research and technology are outlined. R.T.K.

N64-20533 Lockheed Missiles and Space Co., Sunnyvale, Calif.
BIBLIOGRAPHY OF LMSC BIBLIOGRAPHIES [1958-1963]
Jan. 1964 76 p refs
(SB-64-7; Rept.-5-10-64-2)

This publication is a listing of all bibliographies generated by the LMSC Technical Information Center between 1958 and 1963. Entries are arranged alpha-numerically by report coding. Subject and personal author indexes are included. Author

N64-20564 Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.
TASK R Quarterly Progress Report No. 20, 1 Jan.-31 Mar. 1964
A. A. Westenberg et al [1964] 40 p refs
(Contract NOw-62-0604-c)
(SR-4-4; AD-439089)

In dissociated gas studies the flow-tube technique for determining atom–molecule diffusion coefficients using ESR detection is discussed. Some preliminary experiments are described. In molecular-beam chemical kinetic studies aerodynamic beams of Ar, He, and N_2 were obtained using both the porous nozzle and two convergent nozzle sources. Highest intensities were about 3×10^{17} molecules cm^{-2} sec^{-1}. Studies were undertaken in rocket-nozzle fluid dynamics. The high-temperature calibration cell for the fast-scanning infrared spectrometer measurements is described. Results on CO_2 in both emission and absorption are presented and discussed. Both cell temperature and pressure have been varied. Author

N64-20569 Aerospace Corp., El Segundo, Calif.
FINAL BIBLIOGRAPHY OF REPORTS, 1 JULY 1962 THROUGH 30 JUNE 1963
B. H. Peer and S. T. Keasbey, comp. 1 May 1964 80 p refs
(Contract AF 04(695)-169)
(CSR-169(9990)FBR-1; AD-438720)

Reports listed are sectionalized in four categories: (1) contract status reports; (2) technical operating reports; (3) technical documentary reports; and (4) other reports. Page entries contain the following information: item number, Aerospace report number, title, author, publication data, and classification—security classification and those listed as limited access by Aerospace Corporation. The report-subject areas include: Mercury Launch Vehicle Program, Project Advent, Satellite Control Program, Reentry Systems Program, engineering technology, materials and structures, reliability, Gemini Launch Vehicle Program, advanced ballistic reentry systems, propulsion research aeromechanics, instrumentation and test engineering, Standard Launch Vehicle II and III, manned space systems, ballistic missile systems, and spacecraft subsystems and techniques. R.T.K.

N64-20593* National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
1963 PUBLICATIONS
W. A. Mrazek 3 Feb. 1964 25 p refs
(NASA TM X-53006) OTS: $2.60 ph

"1963 Publications" is a compilation of official abstracts of Marshall Technical Papers and Internal Notes, written by personnel of the Materials Division, released during 1963.
Author

N64-20599* Michigan U., Ann Arbor
THIRD QUARTERLY STATUS REPORT, AUGUST 1-OCTOBER 31, 1963
20 Mar. 1964 5 p
(NASA Contract NASr-54(03))
(NASA CR-53970; Rept. 05863-3-P) OTA: $1.10 ph

The project effort was divided into the following tasks: (1) laboratory testing of the four radiation measuring instruments returned from a balloon flight; (2) construction and testing of equipment for the aircraft flight tests of the NIMBUS, MRIR, and HRIR radiometers; (3) analysis of data obtained on the balloon flight; (4) study of methods of analyzing data obtained on the "Kaplan" experiment; and (5) study of stellar refraction as a meteorological satellite technique. R.T.K.

N64-20617 Grumman Aircraft Engineering Corp., Bethpage, N.Y.
STRUCTURE REMOVAL WITH EXPLOSIVES (EXPLOSIVE CUTTING PHASE)
A. G. Foster 18 Mar. 1963 26 p refs
(ADR-07-13-63.1)

This report describes the third phase of a four-part project undertaken to bring to fruition several explosive structure removal concepts advanced for the Eagle missile. This phase was concerned with developing an explosive system for segmenting the structure surrounding the warhead prior to deploying it. The structure consisted of a cylindrical stainless steel skin with sections of the wings attached. The requirements of this phase were to quarter the structure without damaging the underlying warhead. Extensive cutting, charge sizing and junctioning, and full-harness detonation tests culminated in the successful demonstration of a linear shaped charge system over a simulated warhead. The cutting test details are discussed and the results presented in a table. Significant features of the cutting and harness detonation tests are illustrated with photographs. Author

N64-20657 Joint Publications Research Service, Washington, D.C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NUMBER 82
12 May 1964 93 p refs Transl. into ENGLISH of articles from various Chinese-Language 1964 Periodicals
(JPRS-24552; OTS-64-31241) OTS: $2.25

CONTENTS:

1. ACTIVE MATERIALS WHICH CAN PRODUCE OPTICAL MASER ACTION S. Liu p 23–56 refs (See N64-20658 13-25)

2. THE SEPARATION AND ANALYSIS OF RARE EARTH ELEMENTS BY PAPER-PHASE PARTITION CHROMATOGRAPHY S.-m. P'ang and S.-c. Liang p 57–59 refs (See N64-20659 13-07)

3. THE UTILIZATION OF α-METHOXY-BENZYL-ACETIC ACID AS PRECIPITANT FOR ZIRCONIUM S.-c. Liang and S.-y. Wang p 60–61 refs (See N64-20660 13-07)

4. ELECTRON MAGNETIC RESONANCE SPECTRA OF V_2O_5 TYPE OF CATALYST K.-c. Hsu, S.-m. Ch'en, and Y.-c. T'ang p 62–69 refs (See N64-20661 13-23)

5. THE MAGNETIC RESONANCE OF AROMATIC HYDROCARBON CARBONIUM IONS T.-y. Chu, K.-h. Fu, C.-l. P'an, H.-y. Sheng, and J.-c. Hu p 70–77 refs (See N64-20662 13-23)

6. THE QUANTITATIVE TITRATION OF SELENIUM T.-c. Tso, H.-l. Li, and K.-c. Sun p 78–84 refs (See N64-20663 13-07)

N64-20669 Hanford Atomic Products Operation, Richland, Wash., Hanford Labs.
HANFORD FORMAL RESEARCH AND DEVELOPMENT REPORTS, 1963
C. G. Stevenson Jan. 1964 36 p refs
(Contract AT(45-1)-1350)
(HW-80524)

This bibliography covers the following categories: (1) biology and medicine; (2) chemistry; (3) engineering and equipment; (4) health and safety; (5) instruments; (6) isotopes; (7) mathematics and computers; (8) metals and ceramics; (9) meteorology; (10) physics; (11) reactor technology; and (12) waste disposal and processing. I.v.L.

N64-20681 Illinois U., Urbana Engineering Experiment Station
A SUMMARY OF ENGINEERING RESEARCH 1963–1964 Bulletin No. 33
Michael B. Shelly, Rima R. Greenberg, John F. Penn, and Paul T. Bryant ed. Nov. 1963 197 p refs

The engineering research picture of the following areas and facilities is presented: (1) aeronautical and astronautical engineering; (2) agricultural engineering; (3) ceramic engineering; (4) chemical engineering; (5) civil engineering; (6) electrical engineering; (7) general engineering; (8) mechanical and industrial engineering; (9) nuclear engineering; (10) mining, metallurgy, and petroleum engineering; (11) physics (nuclear physics, elementary particle physics, physics of solids); (12) theoretical and applied mechanics (dynamic and vibrational behavior of mechanical systems, mechanics of solids and fluids, behavior of materials); (13) the measurement program (maintenance, repair, and checking for accuracy and operation of various types of instruments); (14) the engineering experiment station; (15) the coordinated science laboratory; (16) the materials research laboratory; (17) the digital computer laboratory; and (18) supplementary research facilities. I.v.L.

N64-20684* Maryland U., College Park Computer Science Center
COMPUTER ORIENTED RESEARCH IN THE SPACE RELATED SCIENCES Annual Status Report, Mar. 1963–Mar. 1964
Werner C. Rheinboldt [1964] 87 p refs
(NASA Grant NsG-398)
(NASA CR-56097)

Computer orientated research in the space related sciences is reviewed. A flexible set of programing systems was incorporated into one overall operational system proving itself extremely well adapted to the various demands of the research program. Other work concerned the development of special, general-purpose programing packages, notably for multiprecision computations and for versatile input–output. A closely related research study was started concerning nonsequential procedures and procedural languages as they occur in complex multicomputer and man–machine systems. A first basic version of a flexible and effective crystallographic computing and programing system was completed. An analysis was initiated, of certain automatic pattern recognition problems by the computer synthesis of classes of patterns. An investigation is being conducted of the special algorithmic structure for computer-based information storage and retrieval systems for handling literature in a narrow technical area, indexed in depth and with substantial detail and structure. A project is underway in the general area of computer investigation of potential energy curves and wave functions for diatomic systems. Computer programs were developed for the reduction and analysis of long wavelength radio astronomical observations. Also discussed is computer work in the fields of chemical engineering, fluid dynamics, and applied mathematics. I.v.L.

N64-20699 Hughes Aircraft Co., Culver City, Calif.
EFFECT OF TARGET REDUNDANCY ON KILL PROBABILITY OF FRAGMENTATION WARHEADS Technical Internal Correspondence
A. Hertzberg 11 Nov. 1963 19 p

The effectiveness of target redundancy was investigated to ascertain the achievement of high kill probability of fragments

in a two-dimensional circular pattern. Fuzing diagrams, expressions, and numerical results for kill probability of singly, doubly, and quadruply vulnerable targets are given for both perfect and random positions. Author

02 AERODYNAMICS OF BODIES, COMBINATIONS, AND INTERNAL FLOW

Includes aerodynamics of channels, cowls, ducts, ejectors, nozzles, etc. *For related information see*: 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 11 Fluid Mechanics.

N64-20120 Pennsylvania State U., University Park Ordnance Research Lab.

MEASURED AND THEORETICAL VELOCITY COMPONENTS OF AN 8:1 ELLIPSOID AT AN ANGLE OF ATTACK OF SIX DEGREES

E. J. Rodgers 31 Mar. 1964 79 p refs
(Contract NOw-63-0209-c; Contract NOrd-16597)
(AD-436094)

The experimental velocity components of an 8:1 ellipsoid at a 6° angle-of-attack are discussed. The velocity components predicted by potential theory are included. Plots of the experimental and theoretical velocity components are presented at various stations along the body in planes perpendicular to the longitudinal axis of the body. The model used was an ellipse of revolution with a length-to-diameter ratio of 8 to 1, chosen because it is a typical value for bodies of interest to the fluid dynamicist. The ellipsoid was chosen because the potential solution for the flow over a body of this shape is readily available. To simplify the process of obtaining test data, the model was made as large as possible consistent with the size of the wind tunnel. The test section of this tunnel has a 48 in. octagonal cross section across the flats. The model diameter did not exceed 8 in. to keep interference effects between model and tunnel walls within acceptable limits. This 8-in. diam and the slenderness ratio of 8 to 1 result in a model length of 64 in. Mahogany was chosen as the material for construction. The model was suspended in the wind tunnel test section. Piano wire was fastened to the front and rear of the model by fittings that permitted the model to be rotated for pressure-distribution tests. A turnbuckle was used at each bracket to provide adjustment of the wires for model alignment; this suspension system would cause less flow disturbance than a strut or sting mounting system. Author

N64-20223 Joint Publications Research Service, Washington, D.C.

AERODYNAMIC INVESTIGATIONS OF THE PARAMETERS OF AIR FLOW DIRECTION SENSORS

O. S. Obolenskiy *In its* Turbulent Diffusion in the Surface Layer of the Earth's Atmosphere 6 May 1964 p 270–278 (See N64-20201 13-21) OTS: $5.00

The aerodynamic investigations described show that the geometric parameters of a circular fin assembly for an airflow direction sensor exert a significant influence on its inertia qualities. The best choice for a bivane is a ring stabilizer with an angle of taper oriented in the direction of flow, 6° to 8°, and with slits in the surface of the ring. The use of slits in the ring with the angle of taper oriented in the direction of flow considerably lowers the maximum values A'/A at all airflow velocities and exerts no influence on their position relative to P. Author

N64-20282* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

DYNAMIC-MODEL INVESTIGATION OF A 1/20-SCALE GEMINI SPACECRAFT IN THE LANGLEY SPIN TUNNEL

Henry A. Lee, Peter J. Costigan, and James S. Bowman, Jr. Washington, NASA, May 1964 Film Suppl. L-788 Available on Request 17 p refs
(NASA TN D-2191)

An investigation has been conducted at low subsonic speeds to determine the behavior of the Gemini spacecraft in vertical descent. The investigation was made to study (1) the stability of the spacecraft alone in vertical descent, (2) the motion of the spacecraft during the deployment of a drogue parachute, and (3) the drogue-parachute configuration required to stabilize the spacecraft in vertical descent. The results of the investigation are given in terms of full-scale dimensions. The dimensions of the parachutes were determined by using an assumed drag coefficient of 0.55 based on the laid-out-flat diameter. The results of the investigation indicate that the Gemini spacecraft alone is very unstable. In various cases the spacecraft oscillated, tumbled, or entered spinning motions about the vertical wind axis with the symmetrical axis of the spacecraft inclined as much as 90° from the vertical. The tests also indicate that the deployment of a 6-ft-diam drogue parachute during any spinning or tumbling motions of the spacecraft will quickly terminate these motions. Author

N64-20290 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

AERODYNAMIC BALANCES

V. I. Zimenkov 23 May 1963 4 p Trans. into ENGLISH from Russian Patent No. 135271, 1961 p 1–2
(FTD-TT-63-380/1+2; AD-409092)

An aerodynamic balance for measuring forces affecting a test model in a wind tunnel is described. A major departure from other designs is that the mobile table supports form a float submerged in a liquid. The effect of friction is eliminated, and greater accuracy of measurement is achieved. J.E.T.

N64-20364 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

CONTRIBUTION TO THE THEORY OF FLOW OF SUPERSONIC GAS PAST A WEDGE

S. Z. Belen'kiy *In its* Trans. of the Physics Inst. 21 Mar. 1963 p 4–19 refs (See N64-20363 13-01)

An investigation is made of the possibility of plotting the flow of a stream of gas past a dihedral angle (i.e., wedge). Experiment has shown that in such a flow the mode realized will correspond to a high velocity behind the oblique compression shock, but this premise cannot be proved as a mathematical theorem. Possible solutions to the problem are theorized by application of the fundamental equations of gas dynamics to an oblique shock. However, it is concluded that the solutions are not equally valid in the case of a finite wedge. A.W.

N64-20379 Cook Electric Co., Chicago, Ill. Cook Research Labs.

DYNAMICS OF SEPARATING BODIES. VOLUME IV: DYNAMIC EJECTIONS AT MACH NUMBERS OF 2, 4, 5 AND 8

R. D. Turner Holloman AFB, N. Mex., Offices of Res. Analyses, Dec. 1963 141 p
(Contract AF 29(600)-295)
(ORA-63-15; AD-437571)

Dynamic models were ejected from the side and base of a carrier vehicle at Mach numbers of 2, 4, 5, and 8. Two capsule shapes were investigated in this program to enable determination of the effects of capsule geometry. The flared capsule

configuration was ballasted in two ways to provide two pitch moments of inertia. The cylindrical shape capsule possessed one moment of inertia. The data obtained from these ejections were in the form of high-speed motion pictures. The Mach 2, 4, and 5 data were obtained through a Schlieren optical system. The Mach 8 data were obtained with a conventional high-speed camera. All 55 data films were analyzed, and trajectories are presented. Qualitative descriptions of the dynamic behavior and preliminary quantitative calculations were performed to compare the aerodynamic coefficients obtained from the dynamic tests with those previously obtained from static tests. Author

N64-20426 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Freiburg (W. Germany) Institut für Angewandte Mathematik und Mechanik

ON TAYLOR'S STABILITY PROBLEM OF ROTATING CYLINDERS WITH AN ADDED AXIAL FLOW [UBER DAS TAYLORSCHE STABILITATSPROBLEM BEI ZUSATZLICHER AXIALER DURCHSTROMUNG DER ZYLINDER]

I. Kiessling Porz-Wahn, DVL, Dec. 1963 88 p refs In GERMAN

(DVL-290) Available from Vereinigte Universitats U. Fachbuchhandlungen, R. Wagner Str. 1, Cologne, (W. Germany)

This paper deals with the stability problem of viscous incompressible flow between coaxial circular cylinders with respect to spiral disturbances. The investigations are restricted to the case in which the gap between the two cylinders is small compared with their mean radius. The basic flow is generated by corotation of the cylinders with generally different angular velocities and by a relative axial displacement of the cylinders. By linear perturbation theory the hydrodynamic equations of motion lead to eigenvalue problems for ordinary differential equations. For a certain class of spiral disturbances, the stability problem can be reduced to the well-known Taylor problem. The case of general spiral disturbances is treated by numerical methods. The result is a destabilizing effect caused by the relative axial velocity of the cylinders. Author

N64-20442 National Aeronautical Lab., Bangalore (India)

PERFORMANCE OF A TWO-DIMENSIONAL CENTRE-JET EJECTOR

M. Surendraiah and D. M. Rao Jul. 1963 30 p

(TN-AE-18-63)

Results of exploratory experiments carried out to determine performance of a two-dimensional center-jet ejector are presented. With a fixed sonic primary jet, a range of area ratios, primary and secondary flow pressure ratios, and mixing lengths were investigated. The present results lead to a tentative conclusion that this type of ejector is potentially more efficient than a wall-jet type. Author

N64-20456 Army Missile Command, Huntsville, Ala. Aerodynamic Branch

INVESTIGATION OF FIN GAP EFFECTS ON STATIC STABILITY CHARACTERISTICS OF FIN STABILIZED MISSILES

T. L. Killough 10 Apr. 1964 108 p refs

(RF-TR-64-6; AD-437493)

Experimental investigation of the effects of fin gap on a typical finned, ogive-cylinder model led to two conclusions. First, introduction of gap between the fin and body reduced the total neutral point migration through the Mach number range tested for each configuration. The low aspect ratio fin (A = 1) gave the best results, reducing the model neutral point total shift by 20% at the 0.25-caliber gap setting. Secondly, favorable results in reducing neutral point migration in this study indicated that additional investigation of fin planform and thickness, and body-alone configuration was warranted. Author

N64-20567 California Inst. of Tech., Pasadena Div of Engineering and Applied Science

WATER TUNNEL OBSERVATIONS ON THE FLOW PAST A PLANO-CONVEX HYDROFOIL

R. B. Wade Feb. 1964 53 p refs

(Contract Nonr-220(24))

(E-79-6; AD-436087)

Experimental results of the performance of a plano-convex hydrofoil under noncavitating and cavitating conditions are presented. Lift, drag, and moment coefficients are given as a function of the cavitation number, together with the behavior of the cavity length. Some unsteady effects occurring under cavitating conditions are also considered. In this region of cavitation the magnitude of the force oscillations together with the fluctuation of the cavity length are presented. The frequency of these oscillations and the general behavior of the cavity are discussed. Author

N64-20616 Ohio State U., Columbus

THERMODYNAMIC NON-EQUILIBRIUM IN A HIGH ENTHALPY NOZZLE FLOW

E. Stokes Fishburne 1963 26 p refs Presented at the Spring Meeting, Western States Sect., Combust. Inst., San Diego, Calif., 29–30 Apr. 1963

(Contract AF 33(657)-7561)

(Paper-63-2)

Argon containing less than 0.01% nitrogen is heated by a direct current arc and is expanded through a De Laval nozzle. Emission spectra are obtained of argon, molecular nitrogen, atomic nitrogen, atomic oxygen, and other contaminants. This paper deals primarily with the excitation mechanism leading to the high electronic energy levels in which these molecules were observed. Since thermal electrons are present in the expanded gas, these electrons can be the primary source for the radiation. The effect of metastable argon and metastable nitrogen molecules in the expanded gases is also discussed. Evidence is given that the observed second positive radiation is due primarily to a collision between an electron and the metastable nitrogen molecule. Author

N64-20680 Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.

INVISCID, NONADIABATIC FLOW ABOUT BLUNT BODIES
Technical Report, Flight Sciences

K. H. Wilson and H. Hoshizaki Jan. 1964 54 p refs

(Rept-6-90-64-1)

The problem considered in this paper is that of determining the inviscid, nonadiabatic flow field resulting when energy loss by radiation becomes significant. The approach taken is to include the radiation term in the energy equation and solve the resulting conservation equations for the flow past a blunt body. The shock layer gas is assumed to be optically thin so that no significant self-absorption occurs. The direct blunt-body problem is solved using an integral method of solution. The method is equally applicable to adiabatic as well as nonadiabatic flows. An adiabatic solution for the flow past a sphere obtained by this method is in excellent agreement with an exact numerical solution. The nonadiabatic nature of a flow about a sphere and a hemisphere-cone significantly reduced the shock layer thickness about the body and altered the enthalpy profiles within the shock layer. When normalized to the stagnation point value, the radiative heating distribution about the body

does not change significantly between adiabatic and nonadiabatic flows. As expected, the radiative heating is reduced considerably from the adiabatic value for cases where large nonadiabatic effects are present. Author

N64-20728* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THEORETICAL AND EXPERIMENTAL INVESTIGATION OF BOUNDARY LAYER CONTROL IN LOW-DENSITY NOZZLES BY WALL SUCTION AND COOLING
M. R. Bottorff and K. W. Rogers (U. of Calif. Eng. Center) 18 Feb. 1964 63 p refs
(NASA TM X-53008) OTS: $6.60 ph

This report presents the results of a theoretical and experimental investigation on the reduction of boundary-layer thickness in low-density nozzles by wall cooling, wall suction, and a combination of these two. Potentially there is a twofold benefit in reducing the thickness of the nozzle boundary layer: a possible increase in diffuser effectiveness, and a possible reduction in the amount of boundary-layer flow for a specified usable test section size, or an increase in the size of the usable test section for a given nozzle mass flow. The theoretical results were checked by an experiment in which a Mach number 9 to 11 porous nozzle was operated at unit Reynold numbers in the range of 100/in. to 600/in. Pitot pressure surveys were used to determine the exit Mach number and boundary-layer thickness. Theoretical Mach number predictions are shown to agree with the experimental results to within 5%, and boundary-layer-height predictions to within 10%. Author

03 AERODYNAMICS OF WINGS, ROTORS, AND CONTROL SURFACES

Includes ailerons; airfoil sections; cascades; fans; flaps; propellers; rotors; slats; spoilers; etc. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 11 Fluid Mechanics.

N64-20137 IIT Research Inst., Chicago, Ill.
A STUDY OF OSCILLATORY WING PROPULSION Final Report
I. Michelson Nov. 1963 83 p refs
(Contract Nonr-1406(08))
(AD-436778)

The propulsive effect of flapping and general oscillatory wing motions is examined according to basic hydrodynamic principles, which, when suitably synthesized, are expected to represent adequately all the main features of the process in a rigorous physical fashion. Although the effort was intended to be of an exploratory character, simple formulas for propulsive force are obtained on the basis of idealized physical models. Author

N64-20388 General Dynamics/Fort Worth, Tex. Convair Div.
WING LEADING EDGE – INVESTIGATION OF RAIN DAMAGE ON –
J. F. Hunter 15 Apr. 1964 15 p
(Contracts AF 33(657)-11214; AF 33(600)-36200)
(FGT-2728; AD-436702)

Static and air–water tests were performed on 4W5298-1 leading-edge panels to: (1) determine the effect of an outer-skin bond separation on the static strength of a 4W5298-1 wing leading-edge section; (2) duplicate with high-velocity air and water a specified type of outer-skin bond separation; and (3) determine the effectiveness of a thin neoprene coating on the edge of a wing leading edge as a protection from rain damage. The test specimens, procedures, and results are described in detail. R.T.K.

N64-20420 David Taylor Model Basin, Washington, D.C. Aerodynamics Lab.
RHEOELECTRIC MEASUREMENTS OF SOME THEORETICAL EFFECTS OF GROUND PROXIMITY ON WINGS
Harvey R. Chaplin and Lewis W. Masters Jan. 1964 16 p refs
(DTMB-AERO-1068; AD-437305)

An electric analogy to the problem of a wing in ground effect, assuming the shed vortex system to trail straight behind the wing, was established, using Teledeltos conductive paper as the working medium. For the case of uniform downwash, span-loading distributions and effective aspect ratio were measured, as functions of height–span ratio, for plane wings, certain end-plated wings, and for a wing of which the lateral cross section is a circular arc with its center lying at the ground surface. The results indicate that the use of end plates to reduce the ground clearance is relatively ineffective, compared with reducing the ground clearance along the whole span, from the standpoint of increase in effective aspect ratio. Author

N64-20427 SAAB Aircraft Co., Linkoping (Sweden)
AERODYNAMIC FORCES ON A COMBINATION OF A WING AND A FIN OSCILLATING IN SUBSONIC FLOW
Valter J. E. Stark Feb. 1964 39 p refs
(SAAB-TN-54)

A method for calculation of aerodynamic forces on an oscillating combination of a wing and a fin is described. This is based on the linearized theory and constitutes an extension of a method previously developed for isolated finite wings. Results are given for three particular rigid modes and for the Mach numbers 0 and 0.8. Author

N64-20526 SAAB Aircraft Co., Linkoping (Sweden)
CALCULATION OF AERODYNAMIC FORCES ON TWO OSCILLATING FINITE WINGS AT LOW SUPERSONIC MACH NUMBERS
Valter J. E. Stark Feb. 1964 27 p refs
(SAAB-TN-53)

A box method employing a characteristic grid and based upon the source superposition method of the linear theory is used to calculate nonsteady aerodynamic forces on one rectangular and one cropped delta wing. Allowance is made for the downwash singularity at the subsonic leading edge of the cropped delta wing. Results are shown for the reduced frequency 0.9 (based on the semispan) and for Mach numbers M in the range $1.05 < M < 1.42$. Author

04 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc., and specific types of complete aircraft (e.g., Ground Effects Machines, Flexible Wings, STOL, and VTOL); flight tests; operating problems; safety devices; and stability and control. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 30 Space Vehicles.

N64-20017* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE X-15 PROJECT. PART I: ORIGINS AND RESEARCH
John V. Becker Repr. from Astronautics Aerospace Eng., v. 2, Feb. 1964 p 52–61 refs
(NASA RP-139)

Presented is a review of the research and development projects that led to the construction of the X-15 hypersonic aircraft. Possible applications of X-15 hypersonic flight experience to present space exploration efforts are mentioned. IAA

N64-20122 General Mills, Inc., St. Paul, Minn. Electronics Div.
DETERMINATION OF THE SHAPE OF A FREE BALLOON – THEORETICAL DEVELOPMENT Scientific Report No. 1
Justin H. Smalley 2 Aug. 1963 34 p refs
(Contract AF 19(628)-2783)
(Rept. 2421; AFCRL-63-951; AD-436845)

This report summarizes a survey of the literature on thin, flexible, pressure vessels. Equations for the stresses in an axisymmetric balloon are determined. The equations are then rearranged to be most suitable for computation of shape. Derivation of the balloon design parameter Σ is presented. Author

N64-20292 American Inst. of Aeronautics and Astronautics, New York, N.Y.
VEHICLE DESIGN AND PROPULSION
N.Y., AIAA [1963] 231 p refs Tech. Papers from the AIAA/AERON. Systems Div. Meeting, Dayton, Ohio, 4–6 Nov. 1963
AIAA: $5.00 members, $10.00 nonmembers

CONTENTS:

1. DESIGN PHILOSOPHY OF SUBSONIC COMPOUND AIRCRAFT VS OPERATIONAL REQUIREMENTS W. Z. Stepniewski and J. J. Schneider (Boeing Co.) p 1–17 refs

2. DESIGN CONSIDERATIONS CRITICAL TO OPERATIONAL ACCEPTABILITY OF A STOL TRANSPORT M. D. Marks and A. A. Lischer (Mc Donnell Aircraft Corp.) p 18–23

3. ROTARY WING AIRCRAFT DESIGN TRENDS M. A. Wachs and J. P. Rabbott, Jr. (Sikorsky Aircraft Div.) p 24–36 refs

4. THE NEXT FAMILY OF V/STOL AIRPLANES B. R. Winborn (Chance Vought Corp.) p 37–46 refs

5. STRUCTURES AND MATERIALS—CHALLENGE FOR FUTURE AEROSPACE VEHICLES F. E. Barnett (AF Systems Command) p 47–53

6. AIR FORCE MATERIALS LABORATORY PROGRAMS TO ADVANCE THE TECHNOLOGY OF JOINING FOR AEROSPACE APPLICATIONS G. E. Eichelman (AF Systems Command) p 54–59 refs

7. MEASURED VARIATIONS IN THE TRANSFER FUNCTION OF A HUMAN PILOT J. J. Adams and H. P. Bergeron (NASA. Langley Research Center) p 60–64 refs

8. MISSILE ATTITUDE STABILIZATION BY LYAPUNOV'S SECOND METHOD A. W. Merz (Gen. Precision, Inc.) p 65–74 refs

9. PRELIMINARY DESIGN EVALUATION OF STATIC SUPERSONIC AND HYPERSONIC AEROTHERMOELASTIC CHARACTERISTICS FOR WINGED AERO-SPACE VEHICLES C. O. Morris (Boeing Co.) p 75–86 refs

10. THE ROLE OF AUTOMATIC CHECKOUT IN THE SUPERSONIC TRANSPORT E. R. Woods (Gen. Dyn./Convair) p 87–91

11. THE INFLUENCE OF AIRPLANE CONFIGURATION ON SONIC-BOOM CHARACTERISTICS H. W. Carlson (NASA. Langley Res. Center) p 92–97 refs (See N64-20293 13-23)

12. SUPERSONIC AERODYNAMIC CHARACTERISTICS OF SOME SIMPLIFIED AND COMPLEX AIRCRAFT CONFIGURATIONS WHICH EMPLOY HIGHLY SWEPT TWISTED-AND-CAMBERED ARROW-WING PLANFORMS F. E. Mc Lean and D. E. Fuller (NASA. Langley Res. Center) p 98–103 refs (See N64-20294 13-04)

13. LATEST ADVANCES IN INERTIAL NAVIGATION T. C. Rynda (AF Systems Command) p 104–105

14. ATOMIC STANDARDS OF TIME R. D. Haun, Jr. (Westinghouse Elec. Corp.) p 106–114 refs

15. FREE-FLIGHT INVESTIGATIONS OF SUBLIMING ABLATORS AND TRANSPIRATION COOLING AT HYPERSONIC VELOCITIES T. E. Walton, Jr., B. Rashis and C. W. Winters (NASA. Langley Res. Center) p 115–119 refs (See N64-20295 13-13)

16. NUCLEAR GYROSCOPE J. H. Simpson (Gen. Precision, Inc.) p 120–125 refs

17. STATUS OF REFRACTORY METAL SHEET ALLOYS: AVAILABILITY, PROPERTIES, AND FABRICATION T. E. Tietz and R. A. Perkins (Lockheed Missiles and Space Co.) p 126–137 refs

18. THE CASE FOR THE PASSIVE-ADAPTIVE CONTROL SYSTEM E. A. Naumann and H. W. Bedell, Jr. (Bendix Corp.) p 138–160 refs

19. COST EFFECTIVENESS OF THE SUPERSONIC TRANSPORT J. D. Donaldson and A. J. Fokker (Gen. Dyn./Convair) p 161–164 refs

20. THE SILENT MASTER-DESIGN CRITERIA C. J. Schmid (AF Systems Command) p 165–181 refs

21. AN ORGANIZED APPROACH TO THE APPLICATION OF REDUNDANCY TECHNIQUES TO FLIGHT CONTROL SYSTEMS E. A. O'Hern (Autonetics) p 182–191 ref

22. APPLICATION OF BERYLLIUM TO AIRCRAFT GAS TURBINES L. A. Corrigan, C. E. Spaeth, and G. J. Andreini (Pratt and Whitney Aircraft) p 192–200

23. THE INFLUENCE OF AERODYNAMIC RESEARCH ON THE PERFORMANCE OF SUPERSONIC AIRPLANES J. K. Wimpress and J. M. Swihart (Boeing Co.) p 201–215

24. JOINING—THE KEY TO DEPENDABLE HIGH TEMPERATURE STRUCTURES J. Melill (N. Am. Aviation, Inc.) p 216–226

N64-20294* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUPERSONIC AERODYNAMIC CHARACTERISTICS OF SOME SIMPLIFIED AND COMPLEX AIRCRAFT CONFIGURATIONS WHICH EMPLOY HIGHLY SWEPT TWISTED-AND-CAMBERED ARROW-WING PLANFORMS
F. Edward Mc Lean and Dennis E. Fuller *In* AIAA Vehicle Design and Propulsion [1963] p 98–103 refs (See N64-20292 13-04)
AIAA: $5.00 members, $10.00 nonmembers

The studies of twist and camber of isolated wing and wing-body configurations indicate some progress in realizing the low-drag-due-to-lift potential predicted by linearized theory. Investigations of complex, complete airplane arrangements indicate that the favorable trim characteristics provided by twist and camber in combination with component interference effects can lead to configurations with relatively high levels of supersonic performance. Author

N64-20360 Aeronautical Systems Div., Wright-Patterson AFB, Ohio Flight Dynamics Div.
HELICOPTER-TYPE ROTOR DECELERATORS Final Report
R. R. Tyndall Jun. 1963 14 p
(ASD-TDR-63-514; AD-410581)

Helicopter-type rotors presently appear attractive for the deceleration, trajectory control, gliding descent, and final recovery of almost all types of aerospace payloads. The potential of rotors is based upon (1) their inherent virtues of L/D gliding capability, controllability, and soft, flared landing; (2) past experience with uncontrolled rotor-decelerated air-dropped stores; and (3) helicopters having the capabilities of control, autorotation, and flare-out to land. Rotor decelerators have potential, particularly in light of the desired expansion of limited war capability, and applied research is being conducted to explore the feasibility of using rotors for aerospace payload recovery. This effort involves both wind-tunnel testing in the transonic-supersonic range, and free-flight testing at deployment speeds up to Mach 0.9 and analyses. To date, wind-tunnel tests have demonstrated the deployment, operating, and drag characteristics of an 8-ft-diam. rotor decelerator through a Mach number range from 0.5 to 1.5. Analyses have indicated that rotors, as well as providing subsonic performance capability, may have potential as hypersonic glide and drag devices. Thus, rotor decelerator potential embraces the spectrum ranging from relatively low-speed aerial delivery of payloads to suborbital and orbital space vehicle recovery. Author

N64-20390 Army Aeromedical Research Unit, Ft. Rucker, Ala.
A SURVEY OF INTERNAL AND EXTERNAL NOISE ENVIRONMENTS IN US ARMY AIRCRAFT Report No. 2
Donald C. Gasaway and Jimmy L. Hatfield Dec. 1963 145 p
(USAARU-64-1; AD-428331)

This report presents and describes representative internal and external noise environments for each major type of Army aircraft during normal operations. Measurements for all fixed-wing and rotary-wing aircraft are classified, when appropriate, into four major categories: ground operations, hovering flight, normal, and maximum cruise conditions. The contributions of major noise generators in each type of aircraft are discussed in detail. Author

N64-20457 Army Missile Command, Huntsville, Ala. Propulsion Lab.
RF HAZARD DETECTOR ADAPTED TO THE LITTLEJOHN MISSILE SYSTEM
W. L. Strickland 26 Feb. 1964 20 p
(RK-TR-64-9; AD-437919)

The thermistor-type squib hazard detector was adapted to the Littlejohn missile system to be used in an extensive RF hazard test at White Sands Missile Range. It was packaged inside the igniter case. The missile's squib circuit is unaltered electrically. The instrument, as designed and used, was sufficiently shielded to prevent any field effects on the detecting circuitry, which might affect the validity of the data obtained. The detector measured temperature rise on the squib bridgewire and was not frequency sensitive. Its sensitivity was sufficient to detect a temperature rise on the bridgewire of the M-3 squib 57 db below the maximum no-fire level. A temperature rise on the bridgewire was detected when the Littlejohn missile was subjected to a field strength as low as 0.013 v/m. This temperature change was too small to be detected and measured by any other known instrumentation. Author

N64-20549* National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
A STUDY OF HYPERSONIC AIRCRAFT
Douglas E. Wall 21 Apr. 1964 12 p Presented at the ASCE/ITTE 4th Natl. Airport Conf., San Francisco, 22–24 Apr. 1964
(NASA TM X-56001) OTS: $1.60 ph

Results obtained in the hypersonic-aircraft study indicate that the long-range hypersonic-cruise aircraft offers sufficient potential to warrant serious consideration for future missions. Mach number 5 to 6 cruise aircraft designed for hydrocarbon fuel may be competitive with those designed for hydrogen fuel for ranges of approximately 3,000 nautical miles. First-stage recoverable boosters must stage at reasonably high velocities to reduce the takeoff gross weight. Hypersonic aircraft of the type studied will require takeoff velocities of 175 knots to 200 knots. Landing and approach speeds may be comparable to current jet aircraft. Future aircraft must be designed to conform to acceptable sound levels and sonic-boom overpressures. They also should be designed to allow takeoff from existing runways. Airports of the future may require storage of liquid-hydrogen fuel and hydrocarbon fuel. In addition, it may be practical to install liquid-hydrogen-producing plants at the major airport terminals. Author

N64-20628 Federal Aviation Agency, Washington, D.C. Systems Research and Development Service
A STUDY OF THE BIRD-IMPACT RESISTANCE OF WINDSHIELDS FOR HIGH PERFORMANCE TRANSPORT AIRCRAFT
John Sommers, Jr. Mar. 1964 28 p refs
(FAA-ADS-8)

Significant structural design information on bird-impact-resistant windshields was extracted from all available reports of test programs conducted on transport category aircraft since 1956. New state-of-the-art developments were emphasized, and the validity of previously developed design principles was confirmed. The study revealed that the glass–vinyl–glass type windshield continues to be the most utilized design for bird-impact resistance. New developments include the substitution of corrosion-resistant steel for aluminum in the edge design for glass–vinyl panels, the use of an acrylic–vinyl–acrylic laminate in one new aircraft forward windshield, and the incorporation of an acrylic-castable interlayer-acrylic laminate in one skylight window design. Author

N64-20683* National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
OPERATIONAL EXPERIENCE WITH X-15 REACTION CONTROLS
Calvin R. Jarvis and Elmor J. Adkins 21 Apr. 1964 24 p refs Presented at the SAE-ASME Symp. on Position, Attitude and Thrust Vector Control, N.Y. City, 27–30 Apr. 1964
(NASA TM X-56002) OTS: $2.60 ph

The four reaction-control system configurations investigated during the X-15 program include a proportional acceleration command system, on–off proportional rate command and attitude hold systems, and a rate-sensing on–off stability augmentation system. Each of the systems is described briefly, and development problems encountered in hardware design, component compatibility, and systems integration are discussed. The practical aspects of system design and operation are emphasized. Flight experience with each system is also discussed. Flight data showing the results of open-loop and closed-loop control during critical X-15 reentry maneuvers are presented. Author

05 ASTRONOMY AND ASTROPHYSICS

Includes celestial mechanics; and radioastronomy. *For related information see:* 12 Geophysics, and 29 Space Sciences.

N64-20475 Space Technology Labs., Inc., Redondo Beach, Calif.
INTERPLANETARY MATTER: A BIBLIOGRAPHY, 1963 SUPPLEMENT Research Bibliography No. 50
L. R. Magnolia, comp. May 1964 312 p refs Suppl. to N62-16764 17-28 and N63-22775 23-29
(Rept. 9990-6649-KU-000)

This bibliography consists of 662 annotated references on asteroids, comets, meteorites, meteors, micrometeorites, noctilucent clouds, nonterrestrial dust, the origin of the solar system, tektites, the zodiacal light, and related subjects. The majority of the items are those published in 1963 as well as those released in 1963 by DDC (formerly ASTIA) and NASA. I.v.L.

N64-20608* California Inst. of Tech., Pasadena
SURFACE TEMPERATURE VARIATIONS DURING THE LUNAR NIGHTTIME
Bruce C. Murray and Robert L. Wildey Repr. from Astrophys. J., v. 139, no. 2, 15 Feb. 1964 p 734-750 refs
(NASA Grant NsG-56-60; NSF G-25210)

A new photometer incorporating a mercury-doped germanium photoconductor has been used with a 19-in. telescope to measure the 8μ to 14μ brightness temperatures of the shaded lunar surface. Right-ascension scans carried into the lunar nighttime from the terminator show a characteristic pattern of cooling inconsistent with the occurrence of a thick homogeneous dust layer. No difference in nighttime temperature distribution was observed between maria and uplands. However, local areas of higher-than-average brightness temperature were encountered. These indicate extensive exposures of consolidated material. Local temperature anomalies of this type are associated with the bright-rayed craters Tycho and Copernicus, but they are distributed over an area larger than that represented by the respective craters. Two other groups of temperature anomalies were found in otherwise undistinguished mare border areas. Author

N64-20618 Society of Photographic Scientists and Engineers, Washington, D.C. Independent Tracking Coordination Program
TIME AS A MEASURE OF DIRECTION IN SPACE
W. P. Overbeck 28 Mar. 1964 12 p

Three-letter symbols for representing time intervals for rationalized orbital elements are discussed. The symbols include: (1) TNL = universal time; (2) JNT = the modified Julian date; (3) JNL = decimal date and time; (4) TNO = observer's local mean time; (5) NGO = observer's polar distance; (6) LNO = observer's polar angle; (7) QNT = the decimal fraction of the tropical year; (8) JNE = a selected epoch; (9) ENL = time elapsed since the epoch; (10) TNS = local mean time of the earth's shadow center; (11) QNO = observer's sidereal polar angle; (12) QNX = the sidereal polar angle; and (13) NGX = the polar distance. These three-letter symbols and associated logic are applied to problems whose solution involves the finding of the correct combination of polar angles. I.v.L.

06 AUXILIARY SYSTEMS

Includes fuel cells and solar cells; gas turbines; hydraulic, pneumatic and electrical control systems and actuators; and inverters. *For primary propulsion systems see*: 27 Propulsion. *For related information see*: 08 Communications; 09 Electronics; 10 Facilities, Research and Support; 15 Instrumentation and Photography; and 22 Navigation and Guidance.

N64-20100 Edgerton, Germeshausen and Grier, Inc., Boston, Mass.
A SATELLITE-BORNE XENON FLASH OPTICAL BEACON FOR USE ON THE PROPOSED MISSILE RANGE CALIBRATION SATELLITE. COMPONENT EVALUATION AND SUPPORTING STUDIES. Final Report
F. T. Gronberg, R. I. Saunders, and C. Warner 23 Feb. 1964 115 p
(Contract AF 19(628)-2979)
(EG&G-B-2730; AFCRL-64-125(II); AD-438872)

A "tailored" beam reflector is proposed for the range calibration satellite. Descriptions of the following are included: flashtube–reflector assembly, capacitor bank, d.c.–d.c. converter, voltage regulator, sequence controller, telemetry and electrical integration, trigger, relay packaging and mechanical integration, failure effects analysis, plate image analysis, and film emulsion study. R.T.K.

N64-20110 Textron Electronics, Inc., Sylamar, Calif. Heliotek Div.
HIGH EFFICIENCY SILICON SOLAR CELLS Sixth Quarterly Progress Report, 15 Sep.–15 Dec. 1963
Paul A. Berman [1963] 64 p refs
(Contract DA-36-039-SC-90777)
(AD-437942)

Analysis of the performance of the pilot line cells fabricated previously indicates that the basic cell design remains highly efficient at intensities up to 2,000 mw/cm^2, showing a significant improvement in the state-of-the-art. Attempts to significantly reduce cell costs are discussed. Results are presented of an experiment to determine the effect of virgin and scrap polycrystalline material on the efficiency of polycrystalline cells. A radiation experiment on n+/p polycrystalline cells is described, and the results are compared to those obtained on single crystalline cells in various light sources. The results indicate that the n/p polycrystalline and single crystalline cells degrade to the same power value at a flux of about 10^{14} electrons cm^{-2} in a sunlight source, with the percent degradation being considerably smaller for the former cell type. Author

N64-20121 Melpar, Inc., Falls Church, Va.
BIOCHEMICAL FUEL CELL Sixth Quarterly Progress Report, 1 Oct.–31 Dec. 1963
Paul S. May, G. C. Blanchard, and R. T. Foley [1963] 44 p refs
(Contract DA-36-039-SC-90878)
(AD-436338)

This report describes an experimental and theoretical investigation of hydrogen production by microorganisms. Screening studies on new strains of *Clostridium welchii* were conducted. Outstanding hydrogen evolution from freshly isolated strains was observed. Sixteen experiments with 10-liter-volume fermenters were conducted to examine the influence of pH, substrate concentration, inoculum concentration, and buffer concentration. The determining influence of pH was established, and the results were used to set up a 1/2 $(2)^5$ fractional factorial design. Initial mutation experiments on the production of high hydrogen-producing mutants by UV radiation were conducted. Author

N64-20135 Bendix Corp., Sidney, N.Y. Scintilla Div.
THERMAL RELEASING CONNECTOR Final Report
R. W. Brush 21 Feb. 1964 110 p
(Contract DA-28-017-AMC-401(A))
(AD-436825)

A summary of test results on three lots of thermal releasing connectors is presented. All tests were successfully completed, and an optimum design was determined and verified. Environmental testing proved the device can operate as a thermal releasing connector. Initial investigation of the releasing material indicated sufficient physical strength within the operating temperature range. Statistical analyses of each of the three lots are presented with an analysis of the second and third lot results combined. R.T.K.

N64-20159 Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics

RESEARCH ON NEW CONCEPTS IN ENERGY CONVERSION Quarterly Technical Progress Report No. 2, 1 Dec. 1963-29 Feb. 1964

W. D. Jackson, G. A. Brown, J. L. Kerrebrock, and E. N. Carabateas Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Mar. 1964 23 p refs

(Contract AF 33(615)-1083)

(AD-436857)

A resumé of research progress is reported in the following areas: (1) magnetohydrodynamic power generation with liquid metal; (2) liquid–metal magnetohydrodynamic generators; (3) magnetohydrodynamic channel flow; (4) electrical conductivity of two-phase liquid–metal flow; (5) systems with alkali-metal vapor generators; (6) studies of transport phenomena in cesium thermionic converters; (7) electron and ion emission from different crystallographic orientations in vacuum and in cesium; (8) measurements of thermal conductivity in cesium gas; and (9) studies of surfaces. Detailed technical contributions are presented in the following areas: (1) magnetohydrodynamic power generation with liquid metal; (2) friction-factor measurements in liquid–metal magnetohydrodynamic channel flow; and (3) dipole–dipole interactions between a polarizable particle and an adsorbed layer of discrete dipoles. R.T.K.

N64-20163 Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.

EPITAXIAL CONTROL SYSTEM Scientific Report No. 5

Don M. Jackson, Jr. 14 Dec. 1963 26 p

(Contract AF 19(604)-8351)

(AFCRL-64-178; AD-437938)

The epitaxial vapor analysis system development progressed to a point near completion. Several notable features were incorporated in the system. The new batch sampling section was breadboarded and operated satisfactorily. With batch sampling, gas impurity levels of 0.5 ppm were easily monitored; and 5 ppb levels can probably be subject to monitoring. The system can be used with either linear or logarithmic ion current readout. The epitaxial gas control section neared completion. This section will allow sampling over a wide range of doping levels at various points in the gas flow system. Author

N64-20167 General Motors Corp., Indianapolis, Ind. Allison Div.

RESEARCH AND DEVELOPMENT OF AN ADVANCED LABORATORY LIQUID METAL REGENERATIVE FUEL CELL

J. D. Mangus Wright-Patterson AFB, Ohio, Aero Propulsion Lab., Apr. 1964 156 p refs

(Contract AF 33(657)-11032)

(EDR-3740; APL-TDR-64-41; AD-438519)

A successful 68-hr seal was produced in a cell containing all components—potassium, mercury, matrix, and electrolyte. All of the ceramic materials readily available were investigated for chemical compatibility, mechanical strength, and conductivity, leading to the selection of magnesia as a suitable matrix material. Investigations were also conducted on matrix configurations to determine the most desirable configuration for mechanical strength without sacrificing electrical properties, leading to the selection of a matrix with reinforcing ribs. Internal resistances approximately 1/3 to 1/2 of those currently found were predicted. A cell was designed to use for both the single and multiple cell tests. A successful single cell test of 433 hr was run with continuous discharges up to 32 hr, producing power densities in the 50- to 100-mw/cm^2 range. The three-cell unit operated a total of 104 hr with discharges totaling 64 hr. A theoretical analysis of fundamental relationships in the liquid metal cell was made, and the mathematical model correlated with data obtained from the cells. Author

N64-20195 Martin Co., Baltimore, Md.

RADIOISOTOPE FUELED AUXILIARY POWER UNIT Quarterly Progress Report No. 2, Apr.–Jul. 1957

[1957] 74 p

(Contract AT(30-3)-217; Contract AF 33(616)-5042)

(MND-1123) (Declassified)

Progress in the development of an isotope-fueled auxiliary power unit (APU) is reported. The APU is being designed for use in the Advanced Reconnaissance System (ARS). In the first conceptual design report, the APU was oriented in the nose cone of the ARS vehicle. Subsequently, the nose cone was reoriented to face the earth, and photoreconnaissance equipment was placed in the nose. A conceptual design is proposed in which the APU is mounted in the tail section of the vehicle. The overall system design, boiler development, fuel technology, materials development, and the power-conversion system are described. R.T.K.

N64-20196 Martin Co., Baltimore, Md.

RADIOISOTOPE FUELED AUXILIARY POWER UNIT Quarterly Progress Report No. 3, Jul.–Oct. 1957

Oct. 1957 56 p

(Contract AT(30-3)-217; Contract AF 33(616)-5042)

(MND-P-1175) (Declassified)

The results of a parametric study of Project Voyager, a dual payload mission for an orbiter and lander launch toward Mars and Venus, are documented. The report discusses a systems analysis, atmospheric entry, guidance and control, communications and power supply, mechanical design, and scientific payload. These studies were conducted to enhance the threefold objective of Voyager—cosmological significance of Mars and Venus, design criteria for manned planetary operations, and feasibility of planetary colonization. G.D.B.

N64-20197 Martin Co., Baltimore, Md.

RADIOISOTOPE FUELED AUXILIARY POWER UNIT Quarterly Progress Report No. 4, Oct. 1957–Jan. 1958

[1958] 73 p

(Contract AT(30-3)-217)

(MND-P-3001) (Declassified)

The status of the following areas is discussed: (1) the construction of a suitable heat-transfer mercury test loop that can be operated with a full-size boiler mockup under environmental conditions of both launch and outer space; (2) the design of a new half-power boiler mockup to replace the full-size boiler in the heat-transfer test loop; (3) fuel assembly studies; (4) the corrosion testing of various metals in contact with liquid lead, mercury vapor, and liquid mercury; (5) test rig checkouts; and (6) overall system design. Also, charts of the postorbit procedures for the advanced reconnaissance-system vehicle are presented. I.v.L.

N64-20246 Bendix Corp., Kansas City, Kan.
THE DESIGN AND ADVANTAGES OF AN AIR-ACCELERATED IMPACT MECHANICAL SHOCK MACHINE
L. F. Thorne *In* Defense Dept. Shock, Vibration and Assoc. Environ., Pt. 3 Mar. 1964 p 81–84 (See N64-20235 13-01)

Modifications were made to a standard 6-in. Hyge mechanical shock actuator, so that "reverse firing" could be accomplished. In this application, the Hyge is utilized as a velocity generator by accelerating a shaft-mounted specimen carriage into an impact material positioned between the carriage and the top of the Hyge machine. The reverse Hyge design, its operation, and its advantages over the original system are described. A curve showing theoretical energy of the machine at inches of displacement is presented. Measured preshock velocities are reflected in a graph showing actual energy, and in information on the percent of shock pulse velocity change attributed to the rebound of the impact material. Author

N64-20279 Purdue Research Foundation, Lafayette, Ind.
ADAPTIVE AND SELF-OPTIMIZING CONTROL Annual Summary Report, Feb. 1, 1963–Feb. 1, 1964
Rufus Oldenburger 1 Feb. 1964 5 p refs
(Contract Nonr-1100(20))
(AD-429297)

The steering functions for the optimum control of systems in which the time rate of change of the controlling variable is assumed to be variable were investigated. A mathematical theory was developed that explains why a controller chosen to yield optimum response to ramp load disturbances for the system subject to input saturation gives remarkably good results in the case of arbitrary disturbances. A survey of the state of the optimal control file was written. The study of the response of a delay line synthesizer model of a first-order system to a given input and the response of this system to the same input was completed. R.T.K.

N64-20345 Gulton Industries, Inc., Metuchen, N.J. Alkaline Battery Div.
INVESTIGATION OF METHODS LEADING TO THE DETERMINATION OF THE STATE OF CHARGE OF NICKEL-CADMIUM BATTERIES Final Report No. 4, 1 Jan. 1963–30 Dec. 1963
J. Wartell and H. N. Seiger [1963] 96 p refs
(Contract DA-36-039-AMC-00109(E))
(AD-435989) OTS: $8.60

Equivalent circuit measurements were made on BB418 cells as a function of residual capacity and time at 200 and 400 cps. No useful correlation with residual capacity was found. A correlation was found with the equivalent circuit product CR_c for low-frequency data taken previously. To pursue this further, different types of cells were tested at 10 cps. The BB418 cells were manually cycled, automatically cycled, and stored, and C and R_c were measured as a function of time and residual capacity at 10 cps. The BB418 cells showed the most consistent results, namely that a correlation was found with residual capacity after cells were recently charged or discharged. Circular, sealed cells did not show any consistent relation between C or R_c and residual capacity. Cells placed in storage did not show any significant change of C or R_c with time in storage. Author

N64-20370 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
A SELF-ADJUSTING SYSTEM WITH GRADIENT SEEKING BY THE AUXILIARY OPERATOR METHOD
L. G. Yevlanov 16 Dec. 1963 17 p refs Transl. into ENGLISH from Izv. An SSSR, Otd. Tekhn. Nauk: Tekhn. Kibernetika (Moscow), no. 1, 1963 p 113–120
(FTD-TT-63-1109/1+2+4; AD-429104)

This article analyzes quality criteria from the point of view of their possible use in self-adjusting control systems. Special attention is given to the speed with which these criteria are obtained and to the accuracy of their calculation. Examined is the determination of the pulse transient response system frequency characteristic for statistical signals and sampling action. Restrictions occurring in connection with the use of extremal parametric self-adjusting systems are examined. A quality criterion is proposed that permits the response time of the self-adjusted loop to be increased. Author

N64-20375 Rocketdyne, Canoga Park, Calif.
HIGH-ENERGY BATTERY SYSTEM STUDY Quarterly Progress Report No. 2, 1 Oct.–31 Dec. 1963
J. Farrar, R. Keller, and C. J. Mazac Ft. Monmouth, N.J., Army Electronics Res. and Develop. Lab., [1963] 25 p refs
(Contract DA-36-039-AMC-03201(E))
(R-5405-2; AD-435627)

Several prospective electrode materials were examined in half-cell studies with a variety of electrolytes. Electrodeposited lithium showed favorable potentials and low polarization, but the measured efficiencies did not exceed 60%. Magnesium showed a high efficiency, but passivation phenomena were observed causing delay action. The aluminum potential is not negative enough for this anode to be coupled with solid cathodes in high-energy batteries. AgO, MnO_2, NiF_2, and $NiCl_2$ were mixed with carbon and tested as cathodes. The first two appeared promising. A periodic current interruptor was constructed to distinguish between activation and electrolyte resistance polarization (IR drop). Author

N64-20487 Phillips Petroleum Co., Idaho Falls, Idaho
SAFETY ANALYSIS REPORT – SNAPTRAN 2/10A-1 SAFETY TESTS
J. M. Waage, ed. 28 Jan. 1963 237 p refs Prepared in cooperation with Atomics International
(Contract AT(10-1)-205)
(IDO-16825) OTS: $3.00

The objectives of the safety tests are to demonstrate and determine the consequences of nuclear accidents approximating the maximum credible, and to provide information for greater nuclear safety. This test series provided safety information on the beryllium reflected SNAP 2/10A reactor in an atmospheric environment. The flight reactor was modified to permit rapid reactivity addition for the tests. The experimental program included reactor kinetic tests to measure the dynamic coefficients of the reactor, static physics measurements to interpret kinetic test results, and a nuclear excursion approaching the maximum credible. A brief description is contained of the experimental program, a description of the reactor test package and control system, a description of the test site and facilities, a discussion of the operating philosophy and test procedures, and an evaluation of the potential hazards of the experimental program. Evaluation included materials handling and control, possible operator error and system failure, radiological hazards associated with the static and nondestructive kinetics tests, and the consequences of the destructive test. The tests themselves were safe. Author

N64-20513 Merz-Chambers Corp., Indianapolis, Ind. Engineering Div.
FLIGHT PROGRESS STRIP LOADER TYPE II Final Report

Dec. 1963 19 p
(Contract FAA/ARDS-448)
(RP-64-22)

The purpose of this project was to develop a device capable of automatically separating perforated fanfolds of flight progress strips into individual strips, loading the individual strips into nylon holders, and delivering the loaded holders to an operator at a rate of 60/min. The original design approach was to separate the strips and draw them longitudinally into the holder, requiring a strip travel of over 10 in. That approach was abandoned in favor of one for laterally inserting the strips into the holder, providing a strip travel of only 1 in. and maximum mechanical linkage motions of about 3 in. Although the Flight Strip Loader Type II is functionally acceptable, improved operation and component accessibility may be obtained by revising certain sections of the machine. Author

N64-20515 National Bureau of Standards, Washington, D.C.
IMPEDANCE OF COMMERCIAL LECLANCHE DRY CELLS AND BATTERIES
Ralph J. Brodd and Harold J. De Wane 5 Jul. 1963 74 p refs
(NBS-TN-190) GPO: $0.40

An extensive study of the impedance characteristics of the most commonly used sizes of commercial Leclanché-type dry cells and batteries was made through the frequency range of 50 to 50,000 cycles. Changes in impedance due to aging and use were determined. Open-circuit voltages and flash currents were measured, and capacities determined on standard tests in an effort to find a possible correlation between any of those three parameters and residual capacity. Data obtained are displayed in tabular form and on Argand diagrams. Author

N64-20555 Weapons Research Establishment (Australia)
POWER SUPPLIES, SALISBURY AND WOOMERA FACILITIES DIVISION
Oct. 1963 34 p
(WRE-TN-FAC-5)

This note gives a brief outline of the power supplies available at Salisbury, Woomera, and sites remote from the South Australian Electricity Trust and from fixed and mobile diesel alternators. Wiring methods, rules and regulations, earthing, hazardous locations, and standards of supply are also covered. Author

N64-20561 Thermo Electron Engineering Corp., Waltham, Mass.
THERMIONIC CONVERTER LIFE AND REPEATABILITY INVESTIGATION First Quarterly Progress Report, 2 Jan. 1964-31 Mar. 1964
C. Z. Kamien [1964] 40 p
(Contract AF 33(615)-1348)
(TE-60-64; AD-436310)

The goals of the program are to develop a clear understanding of the factors affecting the life and performance of thermionic converters through the use of adequate diagnostic tools, and to acquire the technology and techniques to design and fabricate experimental converters with long life and high power output on a repeatable and predictable basis. Toward these goals, life test equipment was designed to enable testing any converter for long-sustained life as well as for cyclic life evaluations. Furthermore, diagnostic facilities are incorporated in the design of the life test stations. In addition to the life test equipment, a cesium vapor, repairable thermionic converter was designed and fabricated. Author

N64-20582* Goodyear Aerospace Corp., Akron, Ohio Space Systems Div.
RIGIDIZED INFLATABLE SOLAR ENERGY CONCENTRATORS Second Quarterly Progress Report, 1 Jan.-31 Mar. 1964
M. Jouriles and C. E. Welling 15 Apr. 1964 44 p refs
(Contract NAS1-3301)
(NASA CR-53991; GER-11541) OTS: $4.60 ph

The areas of investigation include (1) chemical and physical property determination of azides, (2) the reduction of heat releases during foaming, (3) sublimation losses during foaming, and (4) the influence of temperature on the foam product. The report analyzes various approaches that were taken during the course of the investigation, and describes the results that were obtained. Author

N64-20583* Electro-Optical Systems, Inc., Pasadena, Calif.
POROUS IONIZER DEVELOPMENT AND TESTING Final Report
M. La Chance, G. Kuskevics, and B. Thompson 12 May 1964 155 p refs
(Contract NAS3-2519)
(NASA-CR-54016; EOS-3720-Final) OTS: $11.50 ph

Extensive research on the fabrication and performance testing of spherical powder tungsten ionizers is described. Research of the entire spectrum of powder metallurgy, from powder classification through characterization of the ionizers fabricated, is also described. Ionization testing of classified spherical powder ionizers, at three different levels of pore size refinement, was performed. The data presented indicate that successive refinement of pore structure leads to progressively improved ionization performance. Author

N64-20629* Microelectron, Inc., Santa Monica, Calif.
PRECISION CURRENT LIMITERS Final Report, Jul. 1963-Feb. 29, 1964
D. L. Mitchelson Feb. 1964 74 p
(NASA Contract NAS5-3481)
(NASA CR-56085) OTS: $7.60 ph

The objective of this study was to develop a complete line of precision current limiters in the 1/32-amp to 5-amp range having a blow time of 1 second at 200% of rated current. Theoretical calculations were made to determine the modifications to current limiter types required to meet the standards of this contract. Decreasing the resistance of limiters in each rating category was accomplished. Using the overall device designs resulting from the preliminary study, experimental work was done on each limiter rating to establish individual design requirements for that particular rating. The detailed characteristics of the current limiters were determined from a series of load life, stability, clearing time, momentary overload, and case temperature tests. The contract objectives were met for all rating values with the exception of the 1/32-amp device; its yield was low and the reliability unpredictable. The resistance of the limiters varies from 25.0 ohms for the 1/16 amp to 0.022 ohms for the 5 amp. Author

N64-20630* Electric Storage Battery Co., Yardley, Pa. Carl F. Norberg Research Center
ALKALINE BATTERY SEPARATOR STUDY Third Quarterly Report, 28 Dec. 1962-28 Mar. 1963
C. Garvin Oberholzer and E. Weiss 11 Apr. 1963 28 p refs
(NASA Contract NAS5-2860)
(NASA CR-56084; ESB-7054.3) OTS: $2.60 ph

Tensile strength measurements were made of cellulose that had undergone alkaline hydrolysis in an anaerobic medium. Measurements were also made of the dry and wet tensile strengths of certain commercially available separator materials. Oxidation resistance was studied through the use of sodium hypochlorite, gaseous oxygen, and potassium permanganate. The last named proved to be the most useful because all membranes could be tested in it. Results of all measurements and oxidation studies are given in tabular form. A.W.

N64-20645* Eagle-Picher Co., Joplin, Mo.
INVESTIGATIONS LEADING TO THE DEVELOPMENT OF A PRIMARY ZINC-SILVER OXIDE BATTERY OF IMPROVED PERFORMANCE CHARACTERISTICS Summary Report No. 2, 1 Jan.-31 Mar. 1964
B. R. Hawkins 30 Apr. 1964 25 p
(NASA Contract NAS8-5493)
(NASA CR-56077; CPB-13-1600-63) OTS: $2.60 ph

An investigation into the effect of cell construction variables on battery-performance characteristics is discussed. Several of these construction variables were selected for a study to evaluate the effects and to allow the design of a primary zinc–silver oxide cell of improved performance characteristics. Data obtained in the investigation were interpreted by means of half-normal plots. The following conclusions are reached as a result of the investigation: (1) Half-normal plots, if interpreted correctly, yield a conservative estimate of significance of main effects in fractional factorial experiments. (2) Several variables have been revealed to be significant in their effects upon cell-performance characteristics—additives to the electrolyte, electrolyte concentration, positive and negative grid metals, negative material density, additives to the negative material, and method of formulation of the negative material. (3) Sufficient data have been obtained to design a preprototype primary zinc–silver oxide cell of improved characteristics. P.V.E.

N64-20647* Massachusetts Inst. of Tech., Cambridge School of Engineering
STUDIES OF MOLTEN-SALT THERMOCELLS
Gail D. Ulrich (Ph.D. Thesis) Feb. 1964 137 p refs
(NASA Grant NsG-496; Contracts Nonr-1841(78); DSR-9845; DSR-8848)
(NASA-CR-56014) OTS: $10.50 ph

The purpose of this study was to determine open-circuit voltages of several molten-salt thermocells that had promise for energy conversion, and to formulate an expression that satisfactorily described the effect of known variables on this voltage. The open-circuit voltages of four thermocells were measured experimentally. All four had identical chlorine-on-graphite electrodes, but each contained a different electrolyte. The four pure molten salt electrolytes studied were lithium chloride, sodium chloride, potassium chloride, and silver chloride. Open-circuit voltages were determined as a function of total pressure and of electrode temperatures, which ranged from near the melting points of the salts to 1,300° C. Total pressures were varied from one atmosphere to a tenth of an atmosphere except in the lithium chloride–chlorine system, which was studied at one atmosphere only. From the data, curves showing cell voltage as a function of electrode temperatures and total pressure were formulated. Author

N64-20671* Radio Corp. of America, Princeton, N.J. RCA Labs.
MATERIALS AND METHODS FOR LARGE-AREA SOLAR CELLS Midpoint Report
S. G. Ellis, R. R. Addiss, E. F. Pasierb, R. S. Silver, and P. Vohl 20 Apr. 1964 34 p refs
(NASA Contract NAS3-2796)
(NASA CR-54046)

The preparation and properties of Cu_2S layers were studied in detail. Cu_2S on polycrystalline GaAs films have yielded solar cells approaching 1 cm^2 in size with 1.5% sunlight efficiency. This is limited by the poor compromise between sheet resistance and optical transparency that Cu_2S enforces. Detailed measurements of the V-I characteristics and the variation of junction capacitance with voltage for Cu_2S on single-crystal GaAs diodes were made. They are electrically indistinguishable from metal-semiconductor barriers at present. A new photovoltaic effect was found in some semiconductor films. In this effect the photovoltage increases as the angle of illumination departs from the normal to the film. Voltages higher than bandgap were observed. A start was made on both the sputtering and fast flash-evaporation of GaAs. Author

N64-20702* New Mexico U., Albuquerque Engineering Experiment Station
A STUDY OF THE HALL EFFECT AND MAGNETORESISTANCE FOR LOW VOLTAGE, HIGH CURRENT, DC TO AC CONVERSION Semi-Annual Status Report, 15 Jun. 1962-15 Dec. 1962
Bill J. Harper, Richard Bechtel, and W. W. Grannemann Jan. 1963 62 p refs
(NASA Grant NsG-279-62)
(NASA CR-56131) OTS: $6.60 ph

The classical theory of magnetoresistance derived from the free electron model does not fit the high-purity indium antimonide semiconductor material employed because the density of the energy levels and the scattering mechanisms are functions of the magnetic field. Magnetoresistance effects predicted by the quantum theory vary from quadratic dependence on the magnetic field for very low fields to a linear dependence on the magnetic field for a very high field. In the case of indium antimonide, the magnetoresistance is essentially a linear function of the magnetic field. Geometry of the specimen has a large effect upon its magnetoresistance. The maximum magnetoresistance should occur when the effect of the Hall field is minimized. The Corbino disc is the best configuration for a magnetoresistance device. A rectangular slab configuration was also studied. Two circuit configurations were analyzed using the magnetoresistance elements as a controlled rectifier and computing the efficiency with on-field to off-field ratios of the magnetoresistance device. Neglecting circuit losses and using an on-field to off-field resistance ratio of 50, the theoretical efficiency was about 75%. I.v.L.

N64-20703* Monsanto Research Corp., Everett, Mass. Boston Labs.
FEASIBILITY PROOF OF DRY TAPE BATTERY CONCEPT Final Report, 14 Jun. 1963-23 Jan. 1964
Alexander S. Borsanyi, Bernard A. Gruber, Ralph Kafesjian, Kurt W. Klunder, and John O. Smith 31 Mar. 1964 72 p
(NASA Contract NAS3-2777)
(NASA CR-56132) OTS: $7.60 ph

Feasibility of dry tape battery concept is demonstrated using the divalent silver oxide-zinc couple with potassium hydroxide electrolyte. Tapes coated with Ag_2O_2 have been discharged efficiently (85%) at high current density (150 amp/ft^2) against a zinc block anode in a demonstration device. Methods of making and activating Ag_2O_2 tapes have been devised. Tape speed, electrolyte feed rate, and other operating parameters have been investigated and evaluated as

necessary for the design of a demonstration device. Four such devices were constructed and delivered with sufficient tape decks for several hours of operation. Author

N64-20740* Little (Arthur D.) Inc., Cambridge, Mass.
DESIGN AND CONSTRUCTION OF 4.2°K MASER REFRIGERATOR SYSTEM Final Report
William E. Gifford et al 1 Dec. 1962 44 p refs
(NASA Contract NAS7-100; JPL-950076)
(NASA CR-56168; C-63774) OTS: $4.60 ph

The refrigeration system was designed to cool and maintain a small electronic device at 4.2° K, and is capable of continuous operation under a wide range of ambient conditions (0° to +160° F). The system reduces approximately 750 mw of useful refrigeration at 4.2° K with corresponding smaller amounts of refrigeration at those lower temperatures that are within the capability of the compressor unit. The refrigerator unit consists of a refrigerator circuit, a mechanical drive unit, a Joule–Thompson expansion circuit, a radiation shield, and a vacuum insulation jacket with associated vacuum pumps. The compressor unit consists mainly of a modified commercially available, hermetic compressor and a helium purification system. P.V.E.

N64-20741* Clevite Corp., Cleveland, Ohio Electronic Research Div.
STUDY OF THIN FILM LARGE AREA PHOTOVOLTAIC SOLAR ENERGY CONVERTER Second Quarterly Report, 1 Jan.–31 Mar. 1964
Warren J. Deshotels, Frank Augustine, and John Koenig 17 Apr. 1964 39 p refs
(NASA Contract NAS3-2795)
(NASA-CR-54065) OTS: $3.60 ph

The current program status includes: (1) Thirty-three evaporations were completed yielding 301 individual CdS films on glass and H-Film substrates. Modifications introduced in the evaporator include a thermocouple well in the crucible for monitoring the evaporation temperature, and the installation of effective heat shields around the crucible and the substrate heater resulting in a 50% reduction in power requirements. (2) The use of embossed H-Film substrates significantly reduced the curling of the CdS photovoltaic cells. Arrays of nine, 1 $in.^2$, CdS cells have been made on two H-Film substrates, each substrate measuring 4 in. x 4 in. Individual efficiences of these cells ranged from 1.3% to 2.6% and averaged 2.0% for the 18 cells. (3) Nickel, chromium, and gold made low resistance, ohmic contacts to CdS. Gold was the most convenient because of its solderability. (4) A survey of photovoltaic cells, obtained from 149 evaporations, indicated a set of optimum film properties to be used as a guide in future evaporations. (5) Several CdS cells, fabricated according to a modification of the standard barrier process, exhibited little or no decrease in efficiency as long as 46 days after formation. Also, mathematical models are discussed with reference to a unique determination of the rectification quality of CdS cells as expressed by the exponential term in the simple diode equation. I.v.L.

N64-20742* Mallory (P.R.) and Co., Inc., Burlington, Mass. Lab. for Physical Science
RESEARCH AND DEVELOPMENT OF A HIGH CAPACITY NONAQUEOUS SECONDARY BATTERY First Quarterly Report
[1963] 41 p
(NASA Contract NAS3-2780)
(NASA CR-56177) OTS: $4.60 ph

This report discusses: (1) basic electrochemical principles; (2) the development of a methodology for the study of electrode systems and results relevant to an assessment of the potentialities of a system as a battery electrode; the methodology was developed through work on mercury and silver electrodes in aqueous systems. (3) anodization of mercury in aqueous chloride and hydroxide electrolytes: (4) anodization of silver in aqueous chloride and chromate electrolytes; (5) anodization of cobalt and nickel in aqueous hydroxide electrolytes; (6) anodization of silver in propylene carbonate (0.4 M ethyl pyridium bromide-beryllium chloride); (7) anodization of silver in propylene carbonate (0.5 M LiCl, 0.2 M $AlCl_3$); (8) anodization of silver in propylene carbonate (0.4 M $BeCl_2$, 0.4 M $AlCl_3$); (9) anodization of silver, cobalt, nickel, and iron in nonaqueous electrolytes; (10) anodization of silver in acetonitrile (0.5 M $AlCl_3$); and (11) the preparation of dialkyl beryllium salts for use in the preparation of electrolytes. I.v.L.

07 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy); chemical engineering; chemical properties of materials; and synthesis. *For related information see*: 18 Materials, Metallic; 19 Materials, Nonmetallic; and 26 Propellants and Combustion.

N64-20073 General Dynamics/Fort Worth, Tex.
ANALYSIS OF MIL-H-8446 HYDRAULIC FLUID FOR GELATINOUS AND POLYMERIZED CONTAMINATION
H. J. Weltman 15 Apr. 1964 15 p Presented at the Am. Soc. for Testing Mater., Tech. Committee "O" Symp., Palo Alto, Calif., 16 Oct. 1963
(Contract AF 33(657)-11214)
(FZM-4045; AD-438472)

The contamination associated with MIL-H-8446 hydraulic fluid is largely of a gelatinous nature formed by polmerization of the fluid in service. This contamination is dispersed throughout the fluid in the form of particles ranging in size from over 5μ to less than 1μ. Testing procedures established for contamination analysis of petroleum base hydraulic fluids are not applicable for this type and size range of contamination. A gravimetric procedure was adopted and is described herein. Field testing methods are also described and their results compared with those of the gravimetric procedure. Author

N64-20145 Midwest Research Inst., Kansas City, Mo.
SYNTHESIS OF ELASTOMERS CONTAINING Si-N BONDS IN THE MAIN CHAIN Quarterly Progress Report No. 8, 1 Jan.–31 Mar. 1964
L. W. Breed and R. L. Elliott 14 Apr. 1964 23 p refs
(Contract DA-23-072-ORD-1687)
(AD-436092)

Hydrolytic stabilities of silazane monomers and polymers are correlated with chemical structure, and the requirements for hydrolytically stable structures are defined. New polymers with phenyl or ethyl groups substituted on silicon are described. The ethyl-substituted monomers underwent crosslinking reactions during polymerization and did not give soluble polymers. Thermogravimetric analyses of the phenyl-substituted polymers showed that they are considerably less thermally stable than the methyl-substituted polymers. A series of comparative thermogravimetric analyses in air and nitrogen did not reveal a lack of oxidative stability in the polymers. Author

N64-20186 Temple U., Philadelphia, Pa. Research Inst.
PRODUCTION, ISOLATION AND IDENTIFICATION OF THE OF·, O_2F· AND O_3F· RADICALS Second Quarterly Progress Report, 1 Jan. 1964–31 Mar. 1964
A. D. Kirshenbaum and A. V. Grosse [1964] 18 p refs
(Contract AF 04(611)-9555)
(AD-437465)

Work on the production, isolation, and identification of the OF·, O_2F·, and O_3F· radicals is being continued by both bombardment of O_2BF_4 with H atoms at 77° K, and irradiation of O_2F_2, O_3F_2, and O_2BF_4 with Co^{60} γ-rays at 77° K. O_2BF_4 reacts with H atoms at 77° K to produce O_3; O_2F_2 produces two EPR signals at 77° K; irradiated samples of O_2F_2 give a third signal. This third signal is due to a species formed by the γ-ray irradiation at 77° K that is not thermally stable at 90° K; O_3F_2 produces the same two signals as O_2F_2; and O_2BF_4 is highly paramagnetic. Solutions of O_2BF_4 in anhydrous HF are also being studied. R.T.K.

N64-20271 California U., Livermore. Lawrence Radiation Lab.
TITRATION OF BORIC ACID IN AQUEOUS SOLUTION. A STUDY OF SOME TITRATION VARIABLES
David M. Colman and Lester P. Rigdon 12 Mar. 1964 22 p refs
(Contract W-7405-ENG-48)
(UCRL-7756) OTS: $0.50

The effects of varying the mannitol concentration, type of ions, ionic concentration, and temperature on the titration of aqueous solutions of boric acid with NaOH were studied. The volume of titrant and the pH at the equivalent point were determined from potentiometric curves and by calculating the second derivative of the curve. Data are presented to show that the pH of the solution at the equivalent point may vary from 6.3 to 9.2. The use of potassium hydrogen phthalate rather than boric oxide to standardize the titrant is discussed. Author

N64-20316 Dynatech Corp., Cambridge, Mass.
STUDY OF OXIDES FOR O_2– N_2 SEPARATION Fifth Quarterly Progress Report, 15 Jan.-15 Apr. 1964
30 Apr. 1964 58 p refs
(Contract AF 33(657)-10797)
(Rept. 471; AD-438168)

Major emphasis was placed on the following items: (1) the study of the oxidation mechanism for cobalt oxide to help explain certain discrepancies observed in prior oxidation-rate tests; (2) the further development of unsupported cobalt oxide reactant particles with the objective of increasing reactivity while retaining adequate particle strength; and (3) the support of the rotary-disc-separator test program by developing, manufacturing, and characterizing reactant particles for rotary-disc testing. In addition, some continued effort has been directed toward the development of supported reactant particles with cobalt oxide and palladium reactants. Studies of the effect on the cobalt oxide reactant of certain contaminants present during the rotary-disc testing are also reported. The appendices include data on the measurement of reactant particle porosity and the results of a sequence of sintering tests conducted on two different batches of unsupported cobalt oxide particles to determine how the decrease of surface area and porosity is affected by the sintering history (temperature and time). I.v.L.

N64-20328 Shell Development Co., Emeryville, Calif.
FUNDAMENTAL RESEARCH ON ADVANCED OXIDIZERS Quarterly Technical Report No. 5, Dec. 1963-Feb. 1964
A. M. Benson, V. A. Campanile, R. P. Nielsen, C. D. Wagner, R. M. Curtis et al [1964] 66 p refs
(Contract DA-31-124-ARO(D)-54; ARPA Order 402)
(S-13913; AD-439266)

Two experimental programs are directed toward exploratory synthesis of compounds containing primarily combinations of N, O, F, and Cl. In one of these (shock tube synthesis) a mixture of reactant gases with an inert gas diluent is suddenly compressed and heated by a strong shock wave, further compressed and heated by its reflection, and rapidly cooled by rarefaction after a controlled short time at high temperature. The quenched mixture is then sampled and analyzed for new products. In the second program (radiation chemistry), reactions are initiated by an intense beam of 2 to 3 Mev gamma radiation (bremsstrahlung) in a small sample held at a very low temperature. Products are analyzed by progressive distillation at low pressure into a time-of-flight mass spectrometer. A description of the equipment and its capabilities is presented for both programs. Theoretical work has been devoted to a continued study of the problem of repulsive potentials in ionic lattices and to the exploration of some possible modifications and refinements of the extended Hückel molecular orbital calculations for estimating charge distributions and bonding energies in ions and molecules. Author

N64-20331 Polytechnic Inst. of Brooklyn, N.Y.
THE EFFECTS OF INTERMOLECULAR FORCES ON THE RHEOLOGY OF POLYMERS. I: EFFECTS BELOW THE GLASS TEMPERATURE
Edward P. Otocka and Frederick R. Eirich Mar. 1964 25 p refs
(Contract Nonr-839(32)(FBM))
(PIBAL-687; AD-437336)

Two series of styrene copolymers were prepared, containing, respectively, acidic and basic comonomers. The mechanical properties of these copolymers were determined for several temperatures below T_g. Stoichiometric mixtures of these acidic and basic copolymers were studied over the same temperature range and their mechanical properties compared to those of the parent materials. The stoichiometric mixtures showed increased modulus, tensile strength, and relaxation times. The increases can be related to functional group content and temperature through simple equations. Author

N64-20359 Air Force Systems Command, Wright-Patterson AFB, Ohio AF Materials Lab.
STERIC EFFECTS IN ALPHA-OLEFIN REACTIVITY Technical Documentary Report, Nov. 1962–Jun. 1963
David W. Thomson Nov. 1963 32 p refs
(RTD-TDR-63-4107; AD-428143)

Addition reactions to the double bond of a series of sterically hindered alpha-olefins were carried out. The kinetics of these reactions were measured and the rates of reaction correlated with the steric effects present in the olefin. A theory known as "Newman's rule of six" was successfully applied to alpha-olefins to correlate reaction rates with steric effects and to explain, in part, the difficulty of obtaining desirable polymers from these olefins. Author

N64-20386 United States Rubber Co., Wayne, N.J. Research Center
PHOSPHONITRILIC POLYMERS STABLE AT HIGH TEMPERATURES Quarterly Report No. 2, 1 Feb.–30 Apr. 1964
Harold K. Garner, Gerald J. Klender, and Aspet Merijanian 30 Apr. 1964 34 p refs
(Contract NObs-90089)
(AD-438187)

The objective of this investigation is the development of new thermoplastic and thermosetting resins from phosphonitrilic chloride trimer for high-temperature electrical applications. A polymer from $P_3N_3(OC_6H_5)_{3.5}(OC_2H_5)_{1.25}Cl_{1.25}$ was prepared. Work was done on phenyl, phenoxy, and dimethylamino-blocked monomers, and on the copolymerization of phosphonitriles with hydroquinone. A tetrahydroxy benzene derivative was reacted with $P_3N_3(C_6H_5)_2Cl_4$. Author

N64-20421 Tokyo U. (Japan) Inst. of Industrial Science
CONTRIBUTION TO THE VOLTAMMETRIC STUDY WITH A PLATINUM MICROELECTRODE [CONTRIBUTION A L'-ETUDE VOLTAMMETRIQUE AVEC UNE MICROELECTRODE DE PLATINE] Report of the Institute of Industrial Science, Vol. 13, No. 5, Serial 92
Shinichi Kikuchi and Kenichi Honda Feb. 1964 50 p refs

The use of stationary and rotating platinum microelectrodes as the volumetric electrode is discussed in two parts. The first part deals with the development and theoretical study of various types of solid microelectrodes. An attempt is made to establish the bases for using the microelectrode, such as the effect of the manner in which the potential is applied, the effect of the speed of rotation, the relationship between temperature and diffusion current, the relationship between concentration and diffusion current, and the interpretation of the current-potential curve. The second part is devoted to the application of the rotating platinum microelectrode to certain cathodic and anodic discharges. I.v.L.

N64-20441 Oak Ridge National Lab., Tenn.
SPECTROPHOTOMETRIC DETERMINATION OF LOW CONCENTRATIONS OF NICKEL IN THORIUM METAL USING DIMETHYLGLYOXIME
Wallace F. Carden and Virginia M. Giles 12 May 1964 16 p refs
(Contract W-7405-ENG-26)
(Y-1464) OTS: $0.50

A spectrophotometric method for the analysis of low concentrations of nickel (approximately 50 to 500 ppm Ni) in thorium metal was developed. This method complexes thorium with ammonium citrate and uses dimethylglyoxime as the coloring agent. Author

N64-20461 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
SYNTHESIS OF LINEAR AND CYCLOLINEAR ORGANOSILICON COMPOUNDS WITH PHENYLENESILOXANE CHAINS IN THE MOLECULES
V. E. Nikitenkov 10 Apr. 1964 12 p Transl. into ENGLISH from Vysokomolekul. Soyedin. (USSR) v. 4, no. 1, 1962 p 105–108
(RSIC-158; AD-437960)

Resinous linear and cyclolinear low-molecular organosilicon polymers with phenylenesiloxane chains in the molecules were synthesized. The reaction between cyclic low-molecular crystalline bis-[1.4-bis-(methylhydroxysilane) benzene] cyclodioxide and trimethylchlorosilane was investigated. The reaction yielded a cyclolinear polymer. The cohydrolysis of 1.4-bis-(phenyldichlorosilane) benzene with trimethylchlorosilane led to linear polymers. Attempts to carry out the arylation of 1.4-bis-(methylphenylchlorosilane) benzene were unsuccessful. Author

N64-20462 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
LINEAR POLYFLUORINATED ANALOGOUSLY BIFUNCTIONAL COMPOUNDS AS POTENTIAL MONOMERS
V. V. Shokina 22 Apr. 1964 45 p refs Transl. into ENGLISH from Usp. Khim. (USSR), v. 32, no. 9, 1963 p 1052–1086
(RSIC-165; AD-437962)

Production methods and properties of polyfluorine-containing analogously bifunctional compounds, which may be potential monomers for the production of new fluorine-containing polycondensation polymers, are discussed. The compounds cited are: (1) fluorine-containing diolefins; (2) fluorine-containing allenes; (3) fluorine-containing diols; (4) fluorine-containing simple diesters; (5) fluorine-containing diketones; (6) fluorine-containing dicarboxylic acids; (7) anhydrides and chlorides of fluorine-containing dicarboxylic acids; (8) complex esters of fluorine-containing dicarboxylic acids; (9) complex esters of fluorine-containing diols; (10) fluorine-containing diamides and imides; (11) fluorine-containing dinitriles and diamidines; (12) fluorine-containing diamines; (13) fluorine-containing dinitro compounds; and (14) fluorine-containing bifunctional compounds, containing heteroatoms, which include thia, oxa, and aza compounds, and heteroelement-containing fluorodiolefins. I.v.L.

N64-20481 Oak Ridge National Lab., Tenn.
A VACUUM DISTILLATION SYSTEM FOR CONCENTRATING HEAT-LABILE SOLUTIONS
R. A. Stevens 8 May 1964 24 p
(Contract W-7405-ENG-26)
(K-1594)

A vacuum distillation system for concentrating dilute aqueous solutions of thermally labile solutes at 15° to 25° C was developed. Concentration ratios of 2 to over 100 can be obtained depending on solubility and original volume. Air was removed from the system for operation at the vapor pressure of the water condensate (5.3 mm Hg). Four boilers permit simultaneous concentration of four separate solutions at a water removal rate of approximately 770 ml/hr per boiler. Tests showed over 99% solute recovery for a 30:1 concentration of a 0.00002 N oxalic acid solution. The unit employs a mechanical refrigeration system to condense the distillate at 2° C. Author

N64-20489 DuPont De Nemours (E.I.) and Co., Aiken, S.C. Savannah River Lab.
STABILITY OF FERROUS SULFAMATE IN NITRIC ACID SOLUTIONS
E. Kenneth Dukes and Richard M. Wallace Feb. 1964 9 p refs
(Contract AT(07-2)-1)
(DP-871) OTS: $0.50

The rates of oxidation of ferrous ion in solutions of sulfamic acid and 5.0 to 7.0M HNO_3 were measured at temperatures of 23° to 55° C. From these rates, an expression, $\log k = 4.56 \log [HNO_3] - 5140(1/T° K) + 10.4$, was derived for calculating the rate of oxidation of ferrous ion under these conditions. Author

N64-20494 Oak Ridge National Lab., Tenn.
KINETICS OF THE THERMAL DECOMPOSITION OF BIPHENYL
L. B. Yeatts, Jr., D. N. Hess, H. F. Mc Duffie, and W. T. Rainey, Jr. May 1964 49 p refs
(Contract W-7405-ENG-26)
(ORNL-3602) OTS: $1.25

The initial rates of the thermal decomposition of pure biphenyl in the liquid phase were determined for the temperature range of 422° to 446° C. The products of pyrolysis were separated into three hydrocarbon fractions in a vacuum system and determined quantitatively by gas chromatographic procedures. The amount of biphenyl that had decomposed was found by difference. The presence of water vapor in

the biphenyl during pyrolysis had no noticeable effect upon the rates, whereas the presence of oxygen increased the rates by a factor of about 2 to 4. Results obtained by increasing the surface-to-volume ratio as much as a factor of 1,000 for Pyrex and quartz surfaces indicated that the benzene yield reached a minimum value. Iron and stainless steel surfaces increased the rate of hydrogen formation tenfold. A plausible mechanism is discussed for the uncatalyzed thermal decomposition, and suggestions are made for additional research. Author

N64-20508 Atomic Energy Commission, Washington, D.C. Div. of Technical Information

ANNUAL REPORT OF THE JAPANESE ASSOCIATION FOR RADIATION RESEARCH ON POLYMERS, VOLUME 3

Ichiro Sakurada et al Apr. 1964 642 p refs Transl. into ENGLISH of the Publ. "Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo" vol. 3, 1961 450 p
(AEC-TR-6372) OTS: $7.50

CONTENTS:

RESEARCH REPORTS, OSAKA LABORATORY

1. STUDIES ON THE ENERGY DISSIPATION DISTRIBUTION OF BETA RAYS IN MATTER Y. Nakas et al p 11–47 refs

2. RADIATION INDUCED THERMOLUMINESCENCE Y. Nakai et al p 49–82 refs

3. RADIATION INDUCED GRAFT POLYMERIZATION ON CELLULOSE I. Sakurada et al p 83–134 refs

4. RADIATION INDUCED GRAFT POLYMERIZATION ON POLYVINYL ALCOHOL I. Sakurada et al p 135–212 refs

5. RADIATION INDUCED POLYMERIZATION OF FORMALDEHYDE S. Okamura et al p 213–222

6. RADIATION INDUCED POLYMERIZATION OF KETENE TYPES S. Okamura et al p 223–501 refs

7. SUMMARY RESEARCH REPORT OF THE TOKYO LABORATORY K. Shinohara p 503–510

RESEARCH REPORTS, TOKYO LABORATORY

8. POWER FLUCTUATIONS OF THE VAN DE GRAAFF ELECTRON ACCELERATOR K. Shinohara and T. Shigematsu p 511–520 ref

9. THE 500 CURIE COBALT-60 FACILITY OF THE TOKYO LABORATORY K. Shinohara and T. Shigematsu p 521–532

10. BETA INDUCED CROSSLINKING REACTIONS OF POLYESTER RESIN K. Shinohara and T. Shigematsu p 533–538 ref

11. RADIATION INDUCED CROSSLINKING OF EPOXY RESINS (NO. 2) K. Shinohara and T. Shigematsu p 539–546 refs

12. CRYSTAL STATE AND ESR OF POLYETHYLENE p 547–626 refs

13. BUSINESS REPORT, JAPANESE ASSOCIATION FOR RADIATION RESEARCH ON POLYMERS p 627–656

N64-20560 Atomic Energy Commission, Washington, D.C. Div. of Technical Information

ANNUAL REPORT OF THE JAPANESE ASSOCIATION FOR RADIATION RESEARCH ON POLYMERS, VOLUME 2, 1960

Ichiro Sakurada et al Mar. 1964 716 p refs Transl. into ENGLISH of the Publ. "Nippon Hoshasen Kohunski Kenkyu Kyokai Nempo" vol. 2, 1960 502 p
(AEC-TR-6316) OTS: $7.25

CONTENTS:

1. SUMMARY RESEARCH REPORT, OSAKA LABORATORY I. Sakurada p 1–8

RESEARCH REPORTS, OSAKA LABORATORY

2. GAMMA ABSORPTION ADJACENT TO SCATTERING BODIES I—EXPERIMENTS WITH SEVERAL MODELS Y. Nakai, H. Izura, K. Kimura, and K. Matsuda p 9–16 refs

3. GAMMA ABSORPTION ADJACENT TO SCATTERING BODIES II—APPROXIMATE CALCULATIONS Y. Nakai p 17–23 ref

4. CALORIMETRIC DETERMINATION OF BETA FLUX Y. Nakai, H. Izura, K. Matsuda, Y. Okuda, and K. Kimura p 24–30 ref

5. MEAN BETA ENERGY DISTRIBUTION IN ABSORBERS Y. Nakai p 31–34 refs

6. STUDIES ON THE DISTRIBUTION OF BETA ENERGY DISSIPATION IN ABSORBERS—I. ION CHAMBER MEASUREMENTS OF ENERGY DISSIPATION IN ALUMINUM Y. Nakai, H. Izura, K. Matsuda, and K. Kimura p 35–41 refs

7. ION CHAMBER MEASUREMENTS OF ENERGY DISSIPATION IN BERYLLIUM Y. Nakai, H. Izura, K. Matsuda, and K. Kimura p 42–45

8. BETA DOSIMETRY BY DISCOLORATION OF POLYVINYL CHLORIDE FILM Y. Nakai, T. Hiraoka, H. Izura, K. Matsuda, and K. Kimura p 46–58 ref

9. LOW ENERGY SPECTRUM OF BETA RADIATION Y. Nakai, H. Izura, K. Matsuda, and T. Higashimura p 59–65 refs

10. RADIATION INDUCED GRAFT POLYMERIZATION OF POLYVINYL ALCOHOL—NO. 11. GAMMA INDUCED GRAFT POLYMERIZATION OF STYRENE IN METHANOL I. Sakurada, N. Okada, and E. Kugo p 66–69

11. NO. 12. SEVERAL GRAFT POLYMERIZATIONS OF POLYVINYL ALCOHOL IN AIR I. Sakurada and K. Okada p 70–75

12. NO. 13. RADIATION INDUCED GRAFT POLYMERIZATION OF SEVERAL VINYL MONOMERS ON POLYVINYL ALCOHOL I. Sakurada and N. Okada p 76–78

13. NO. 14. GAMMA INDUCED GRAFT POLYMERIZATION OF 2-METHYL, 5-VINYL PYRIDINE ON POLYVINYL ALCOHOL AND GRAFT POLYMERIZATION OF STYRENE BY PRE-IRRADIATION I. Sakurada, N. Okada, and S. Kitamura p 79–83

14. RADIATION INDUCED GRAFT POLYMERIZATION ON CELLULOSE NO. 3. GAMMA INDUCED GRAFT POLYMERIZATION OF STYRENE ON SEVERAL TYPES OF CELLULOSE I. Sakurada, N. Okada, and N. Hatayama p 84–88

15. NO. 4. GRAFT POLYMERIZATION OF STYRENE ON PRE-IRRADIATED CELLULOSE OF VARYING FINE STRUCTURE I. Sakurada, N. Okada, F. Kimura, and N. Minegawa p 89–94

16. NO. 5. RADIATION INDUCED GRAFTINGS ON SEVERAL TYPES OF CELLULOSE I. Sakurada, N. Okada, F. Kimura, and N. Minegawa p 95–99

17. RADICALS PRODUCED IN IRRADIATED CELLULOSE S. Kawase p 100–104

18. RADIATION INDUCED GRAFT POLYMERIZATION ON POLYETHYLENE AND POLYPROPYLENE I. Sakurada, N. Okada, and T. Shiota p 105–113

19. STUDIES ON HIGH TEMPERATURE IRRADIATION OF POLYMERS NO. 4.—HIGH TEMPERATURE IRRADIATION OF POLYVINYL ALCOHOL (PROGRESS REPORT) I. Sakurada, N. Okada, and H. Abe p 114–117 ref

20. NO. 5.—RESULT OF POST HEATING OF POLYVINYL ALCOHOL IRRADIATED AT ROOM TEMPERATURE I. Sakurada, N. Okada, and H. Abe p 118–120

21. IR ABSORPTION SPECTRA OF POLYVINYL ALCOHOL BOTH HEATED AND HEATED WHILE BEING IRRADIATED I. Sakurada, N. Okada, and A. Tanaka p 121–128 ref

22. RADIATION INDUCED LIQUID PHASE ANIONIC POLYMERIZATION S. Okamura, K. Hayashi, Y. Nakamura, and M. Nishii p 129–130

23. RADIATION INDUCED POLYMERIZATION OF VINYL ETHER S. Okamura, K. Hayashi, H. Nakamura, and M. Nishii p 131–133 refs

24. LOW TEMPERATURE RADIATION INDUCED POLYMERIZATION OF VINYL ACETATE NO. 2.—PROPERTIES OF THE POLYMER AND ATTEMPTS AT SOLID STATE POLYMERIZATION S. Okamura, K. Hayashi, and K. Mori p 134–136

25. RADIATION INDUCED POLYMERIZATION ON A GAMMA ALUMINA BASE S. Okamura, K. Hayashi, Y. Nakamura, and T. Natori p 137–144 refs

26. EFFECT OF SILVER NITRATE ON RADIATION INDUCED POLYMERIZATION OF ACRYLONITRILE DISSOLVED IN DIMETHYLFORMAMIDE S. Okamura, K. Hayashi, and K. Odan p 145–151 refs

27. RADIATION INDUCED POLYMERIZATION OF COMPOUNDS WITH TRIPLE BONDS S. Okamura, K. Hayashi, K. Odan, and Y. Nakamura p 152–153

28. RADIATION INDUCED POLYMERIZATION OF UNSATURATED FIVE-MEMBERED RING COMPOUNDS S. Okamura, K. Hayashi, and H. Hamada p 154–162 refs

29. RADIATION INDUCED POLYMERIZATION OF FORMALDEHYDE NO. 2.—LIQUID POLYMERIZATION S. Okamura, K. Hayashi, N. Yamaoka, and Y. Nakamura p 163–167

30. RADIATION INDUCED POLYMERIZATION OF FORMALDEHYDE S. Okamura, K. Hayashi, and M. Sakamoto p 168–173

31. RADIATION INDUCED POLYMERIZATION OF GLYOXAL S. Okamura, K. Hayashi, and K. Mori p 174–177

32. RADIATION INDUCED POLYMERIZATION OF ACETONE TYPES S. Okamura, K. Hayashi, K. Mori, and Y. Nakamura p 178–181 ref

33. RADIATION INDUCED POLYMERIZATION OF TRIOXANE S. Okamura, K. Hayashi, Y. Nakamura, and M. Nishii p 182–185 refs

34. RADIATION INDUCED POLYMERIZATION OF DIKETENE S. Okamura, K. Hayashi, and H. Kitanishi p 186–189 ref

35. RADIATION INDUCED POLYMERIZATION OF β-PROPIOLACTONE S. Okamura, K. Hayashi, Y. Kitanishi, and M. Nishii p 190–194 refs

36. RADIATION INDUCED POLYMERIZATION OF 3,3-bis CHLORO METHYL OXACYCLOBUTANE S. Okamura, K. Hayashi, and H. Watanabe p 195–200 refs

37. RADIATION INDUCED POLYMERIZATION OF MIXED CRYSTALS BY RING CLEAVAGE S. Okamura, K. Hayashi, and M. Nishii p 201–207

38. DYNAMICS OF RADIATION INDUCED POLYMERIZATION BY RING CLEAVAGE S. Okamura, K. Hayashi, Y. Kitanishi, H. Watanabe, M. Nishii, and Y. Nakamura p 208–211

39. STRUCTURE OF POLYMERS FORMED BY RADIATION INDUCED RING CLEAVAGE S. Okamura, K. Hayashi, Y. Kitanishi, H. Watanabe, M. Nishii, and Y. Nakamura p 212–216

40. RADIATION INDUCED COPOLYMERIZATION OF ALKYLENE OXIDE AND ACRYLONITRILE S. Okamura, K. Hayashi, and H. Watanabe p 217–222 refs

41. GRAFT POLYMERIZATION OF POLYOXYMETHYLENE INDUCED BY IONIZING RADIATION S. Okamura, K. Hayashi, and Y. Nakamura p 223–225

42. SOME ELECTRICAL PROPERTIES OF HEAT TREATED POLYACRYLONITRILE FORMED BY RADIATION INDUCED POLYMERIZATION S. Okamura, K. Hayashi, and K. Odan p 226–232 refs

43. STUDIES ON THE ELECTROLYTIC DISSOCIATION OF ALIPHATIC AMINES BY BETA BOMBARDMENT K. Hirota, H. Otoba, K. Fueki, and M. Hatada p 232–237 refs

44. BETA INDUCED EXCHANGE OF OXYGEN ATOMS BETWEEN CO_2 MOLECULES K. Hirota, H. Terasaki, and M. Hatada p 238–244 refs

45. KETONE SYNTHESIS BY THE RADIATION INDUCED REACTION BETWEEN ACETALDEHYDE AND ISOBUTYLENE (PROGRESS REPORT) K. Hirota, N. Iizuka, and M. Hatada p 245–252 refs

46. RADIATION INDUCED REACTION BETWEEN ACETALDEHYDE AND ETHYLENE—MAINLY ON THE PRODUCTION OF METHYL ETHYL KETONE K. Hirota, H. Ochi, and M. Hatada p 253–260 refs

47. GAMMA INDUCED SYNTHESIS OF TERTIARY ALCOHOLS FROM A MIXTURE OF ISOPROPANOL AND ETHYLENE K. Hirota and M. Hatada p 261–265 refs

48. GRAFT POLYMERIZATION OF POLYETHYLENE PRE-IRRADIATED IN AIR BY A (n α) REACTION K. Hirota, M. Umezawa, and J. Takesaki p 266–273 refs

49. MOISTURE DETERMINATION OF CELLULOSE FIBER USING O^{18} K. Hirota, H. Terasaki, and M. Hatada p 274–282 refs

50. STUDIES ON THE USE OF ESR TO ELUCIDATE THE MECHANISMS OF RADIATION CHEMISTRY REACTION I. Nitta and S. Onishi p 283–294 refs

51. RADICALS FORMED BY THE IRRADIATION OF POLYETHYLENE AND POLYPROPYLENE AND THE EFFECT OF PRETREATING THE MATERIALS I. Nitta, Y. Ikeda, and S. Onishi p 295–305 refs

52. ON THE SINGLET ESR SPECTRA OFTEN SEEN WHEN POLYMERS ARE EXPOSED TO A HIGH RADIATION FLUX I. Nitta, S. Onishi, Y. Ikeda, and S. Sugimoto p 306–309 refs

53. OUTPUT SATURATION OF ESR SPECTRA OF IRRADIATED POLYMERS I. Nitta, S. Onishi, Y. Ikeda, and S. Sugimoto p 310–313 ref

54. RADICAL PRODUCTION CURVE OF IRRADIATED POLYMERS AS DETERMINED BY ESR I. Nitta, S. Onishi, Y. Ikeda, and S. Sugimoto p 314–321 refs

55. STUDIES ON RADIATION INDUCED OXIDATION OF POLYMERS I. Nitta, S. Onishi, and S. Sugimoto p 322–325 refs

56. STUDIES ON RADIATION INDUCED OXIDATION OF POLYMERS—NO. 1. STUDIES ON RADIATION INDUCED OXIDATION OF POLYETHYLENE USING ESR AND IR ABSORPTION I. Nitta, S. Onishi, and S. Sugimoto p 326–342 refs

57. NO. 2. MECHANISM OF THE RADIATION INDUCED OXIDATION OF POLYETHYLENE I. Nitta, S. Onishi, and S. Sugimoto p 343–345 refs

58. NO. 3. RADIATION INDUCED OXIDATION OF POLYPROPYLENE I. Nitta, S. Onishi, and S. Sugimoto p 346–352 refs

59. NO. 4. RADIATION INDUCED OXIDATION OF POLYVINYL CHLORIDE I. Nitta, S. Onishi, and S. Sugimoto p 353–358 refs

60. ON THE EFFECT OF THE ADDITION OF PIGMENTS TO THE RADIATION BEHAVIOR OF POLYMERS I. Nitta, Y. Odan, and S. Onishi p 359–367 ref

61. ON THE RADICALS FORMED BY THE IRRADIATION OF POLYPROPYLENE I. Nitta, S. Onishi, and Y. Shioji p 368–380 refs

62. MECHANISM OF THE RADIATION INDUCED REACTIONS OF POLYVINYL CHLORIDE ESPECIALLY THE COLORING MECHANISM I. Nitta, S. Onishi, and Y. Nakajima p 381–394 refs

63. EFFECT OF HEAT TREATING AND IRRADIATING POLYVINYL CHLORIDE I. Nitta, S. Onishi, and Y. Nakajima p 395–400 refs

64. SUMMARY RESEARCH REPORT OF THE TOKYO LABORATORY K. Shinohara p 401–412

RESEARCH REPORTS, TOKYO LABORATORY

65. SOME CHARACTERISTICS OF THE 3 MeV VAN DE GRAAFF ACCELERATOR K. Shinohara and T. Shigematsu p 413–424 refs

66. CURRENT MEASUREMENTS ON THE VAN DE GRAAFF ACCELERATOR K. Shinohara and T. Shigematsu p 425–430 refs

67. RADIATION INDUCED COPOLYMERIZATION OF ETHYLENE AND TETRAFLUOROETHYLENE H. Sobue and Y. Tabata p 431

68. RADIATION INDUCED POLYMERIZATION OF ALKYL CYANIDES H. Sobue and Y. Tabata p 432–434

69. LOW TEMPERATURE RADIATION INDUCED POLYMERIZATION OF ACETYLENE H. Sobue and Y. Tabata p 435

70. RADIATION INDUCED ADDITION REACTION OF CHLORINE ON ACETYLENE H. Sobue and Y. Tabata p 436

71. RADIATION INDUCED POLYMERIZATION OF ACRYLONITRILE MIXED WITH ETHYLENE H. Sobue and Y. Tabata p 437–438

72. RADIATION INDUCED POLYMERIZATION OF DIMETHYLFORMAMIDE H. Sobue and Y. Tabata p 439

73. GAMMA INDUCED POLYMERIZATION OF 4-VINYL PYRIDINE H. Sobue, Y. Tabata, and H. Kitano p 440

74. GAMMA INDUCED POLYMERIZATION OF 5-ETHYL, 2-VINYL PYRIDINE H. Sobue, Y. Tabata, and H. Kitano p 441

75. RADIATION INDUCED POLYMERIZATION OF CHLORAL H. Sobue and Y. Tabata p 442

76. LOW TEMPERATURE RADIATION INDUCED POLYMERIZATION OF ETHYLENE H. Sobue and Y. Tabata p 443

77. CHANGES IN THE PROPERTIES OF NATURAL RUBBER ON IRRADIATION R. Shimozawa, Y. Tabata, and H. Sobue p 444–448 refs

78. EFFECTS OF GAMMA RADIATION ON NATURAL RUBBER IN CONTACT WITH SO_2 R. Shimozawa, Y. Tabata, and H. Sobue p 449–455 refs

79. RADIATION INDUCED POLYMERIZATION OF ISOPRENE H. Sobue, Y. Tabata and R. Shimozawa p 456–464 refs

80. LOW TEMPERATURE RADIATION INDUCED POLYMERIZATION OF ACRYLONITRILE H. Sobue, Y. Tabata, and M. Hiraoka p 465–468 refs

81. RADIATION INDUCED POLYMERIZATION OF TETRAFLUOROETHYLENE H. Sobue, Y. Tabata, and H. Shibano p 469–470

82. RADIATION INDUCED POLYMERIZATION OF ACROLEIN DIETHYL ETHER M. Ichino, K. Araki, and S. Hoshino p 471–480 refs

83. GRAFT COPOLYMERIZATION OF POLYETHYLENE WITH PROPYLENE AND ANHYDROUS SO_2 A. Amemiya and S. Sekigawa p 481–497

84. RADIATION INDUCED GRAFT POLYMERIZATION ON CELLULOSE S. Shida, Z. Kuri, and T. Yoshimura p 498–500

85. RADIATION INDUCED BRIDGING OF EPOXY RESINS (NO. 1) K. Shinohara and T. Shigematsu p 501 508 refs

86. DOUBLE-QUINTET ESR SPECTRA OF IRRADIATED TETRAFLUOROETHYLENE N. Tamura p 509–515 refs

87. ESR OF TETRAFLUOROETHYLENE IRRADIATED AT LOW TEMPERATURE N. Tamura p 516–521 refs

88. ESR OF POLYCARBONATES (I) K. Kashiwabara and K. Shinohara p 522–525

89. ESR OF IRRADIATED POLYETHYLENE K. Kashiwabara and K. Shinohara p 526–533

90. ESR OF IRRADIATED TEFLON AND THE EFFECTS OF SEVERAL GASES K. Shinohara and T. Matsugashita p 534–537

91. ESR ABSORPTION OF SEVERAL IRRADIATED ALCOHOLS A. Ammiya, N. Tamura, and S. Ogawa p 538–550 refs

92. ESR OF α, α'-DIPHENYL,-β—PICRYL HYDRAZYL H. Ueda, Z. Kuri, and S. Shida p 551–557 refs

93. ESR OF GAMMA IRRADIATED SINGLE CRYSTALS OF SUGAR H. Ueda, Z. Kuri, and S. Shida p 558–566 refs

94. ESR STUDY OF THE REACTIONS OF IRRADIATED ACRYLAMIDE AND META-ACRYLAMIDE WITH GASES H. Ueda, Z. Kuri, and S. Shida p 567–572 refs

95. ESR ABSORPTION OF RADICALS FORMED IN SUGARS H. Ueda, Z. Kuri, and S. Shida p 573–586 refs

96. ESR ABSORPTION OF IRRADIATED ACRYLAMIDE AND META ACRYLAMIDE H. Ueda, Z. Kuri, and S. Shida p 587–597 refs

97. FREE RADICALS FROM POLYMERS IRRADIATED WITH UV Y. Fujiwara, Z. Kuri, and S. Shida p 598–602 refs

98. SATURATION FACTOR OF FREE RADICALS Y. Fujiwara, Z. Kuri, and S. Shida p 603–608 refs

99. DYNAMICS OF FREE RADICAL FORMATION IN POLYMERS Y. Fujiwara, Z. Kuri, and S. Shida p 609–615 refs

100. RADIATION INDUCED OXIDATION OF CYCLOHEXANE—NO. 2. EFFECT OF TEMPERATURE K. Tsuruta, S. Shida, and Z. Kuri p 616–622 refs

101. RADIATION INDUCED OXIDATION OF PHENYL CYCLOHEXANE T. Abe, K. Araki, and S. Hoshino p 623–639 refs

102. ON THE GRAFT POLYMERIZATION OF VINYL MONOMERS ON POLYETHYLENE TEREPHTHALATE K. Araki, K. Otsubo, and S. Hoshino p 640–649 refs

103. RADIATION INDUCED GRAFT POLYMERIZATION ON CELLULOSE M. Ichino, K. Araki, and S. Hoshino p 650–659 refs

104. ESR OF CARBON BLACK K. Otsubo and K. Araki p 660–668 refs

105. RADIATION INDUCED ADDITION REACTIONS OF POLYHALIDES—ON THE ADDITION REACTIONS UNIQUELY INDUCED BY RADIATION K. Araki p 669–671 refs

106. FORMATION OF RADIATION INDUCED GRAFT POLYMERS IN POLYMER·POLYMER-SOLVENT SYSTEM T. Abe, K. Araki, S. Hoshino p 672–675 ref

107. BUSINESS REPORT OF THE JAPANESE ASSOCIATION FOR RADIATION RESEARCH OF POLYMERS (AS OF 31 MARCH 1961) p 676–703

N64-20601* Douglas Aircraft Co., Inc., Newport Beach, Calif. Missile and Space Systems Div.

CHARACTERIZATION OF CERTAIN POLYMERIC MATERIALS Final Report

N. R. Byrd 29 Jan. 1964 32 p refs Prepared for JPL (NASA Contract NAS7-100)

(NASA-CR-56035; Rept. 166-F) OTS: $3.60 ph

Dicyanoacetylene monomer was prepared in 40% yield through the dehydration of acetylenedicarboxamide. The reported melting point for the diamide was in error by 100°C. Other methods for preparation of the dinitrile, e.g., cyanogen bromide reaction with dilithium acetylide, were not successful. The monomer was homopolymerized and copolymerized with

both anionic and free radical initiation. The free radical polymerization was the first such reported for dicyanoacetylene. The copolymerization was effected with styrene as the comonomer, and the rate of polymerization to high conversion was extremely slow when polymerized alone, but increased rapidly when styrene was present in appreciable amount. Attempts at determining the r_1 and r_2 values by chemical analysis were difficult because of the poor results obtained from the elemental analysis. However, by means of the infrared spectra for the copolymers the r_1 (styrene) was 1.40, and r_2 (DCA) was approximately zero. Softening points for the polymers were obtained, as well as a rough approximation of the conductivity. Author

N64-20602* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
REACTION OF ELECTRONICALLY EXCITED O_2 WITH CO
O. F. Raper and W. B. De More Repr. from J. Chem. Phys., v. 40, no. 4, 15 Feb. 1964 p 1047–1052 refs
(NASA Contract NAS7-100)
(NASA CR-56036; JPL-TR-32-572)

Photolysis of solutions of O_2 in CO at 77° K with 2537 A radiation has been found to produce O_3 and CO_2. Absorption of radiation in this wavelength region by O_2 corresponds to the forbidden transition $^3\Sigma_u^+ \leftarrow {}^3\Sigma_g^-$, the Herzberg bands of O_2. Since O_2 but not CO absorbs 2537 A radiation and since O_2 cannot dissociate directly, the reaction must occur between excited O_2 and CO. The quantum yield for O_3 formation in the limit of low O_2 concentration is of the order of 0.33 and increases slightly with increasing O_2. In the concentration range studied, CO_2 is formed somewhat faster than O_3. These results suggest that an intermediate is involved in the reaction that is capable of direct reaction with CO and O_2 to form products. This intermediate is proposed to be CO_3^*, and a mechanism involving this species is postulated. Author

N64-20609* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
POLYMER DEGRADATION. I. COLUMN ELUTION FRACTIONATION AND THERMAL DEGRADATION OF POLYOXYPROPYLENE GLYCOL-TOLUENE DIISOCYANATE (PPG-TDI) POLYMERS
Neville Sue Rapp and John D. Ingham Repr. from J. Polymer Sci., Pt. A, v. 2, 1964 p 689–704 refs In ENGLISH; FRENCH and GERMAN summaries
(NASA Contract NAS7-100)
(NASA-CR-53993; JPL-TR-32-433)

A procedure was worked out for the column elution fractionation of polyoxypropylene glycol-toluene diisocyanate (PPG-TDI) polymers of molecular weight ~100,000; by decreasing the column temperature from 34° to 7° C the method was extended to degraded polymer of molecular weight ~25,000. Graphical differentiation of the integral curves was eliminated by using Tung's empirical equations. The results for both degraded and undegraded polymer agreed with the theoretical most probable distributions; therefore, a random scission process of degradation is indicated. Author

N64-20659 Joint Publications Research Service, Washington, D.C.
THE SEPARATION AND ANALYSIS OF RARE EARTH ELEMENTS BY PAPER-PHASE PARTITION CHROMATOGRAPHY. III. TNOA-NH_4NO_3 SYSTEMS
Shu-mei P'ang and Shu-ch'uan Liang *In its* Transl. on Communist China's Sci. and Technol., no. 82 12 May 1964 p 57–59 refs Transl. into ENGLISH from K'o-hsueh T'ung-pao (Peiping), no. 2, 1964 p 156 (See N64-20657 13-01) OTS: $2.25

Paper-phase separation of trinormal octa-amine (TNOA)–ammonium nitrate systems is discussed. In 1 mg of lanthanum, 1μg of samarium, europium, or gadolinium can be separated out. However, if gadolinium, samarium, and europium exist at the same time, then europium and gadolinium cannot be separated out. A method was also devised to determine the paper-phase rare earth by color comparison. P.V.E.

N64-20660 Joint Publications Research Service, Washington, D.C.
THE UTILIZATION OF α-METHOXY-BENZYL-ACETIC ACID AS PRECIPITANT FOR ZIRCONIUM
Shu-ch'uan Liang and Shun-yung Wang *In its* Transl. on Communist China's Sci. and Technol., no. 82 12 May 1964 p 60–61 refs Transl. into ENGLISH from K'o-hsueh T'ung-pao (Peiping), no. 2, 1964 p 157 (See N64-20657 13-01) OTS: $2.25

Experimental results showed that α-methoxy benzyl acetic acid can separate out white powdery precipitates from a zirconium solution containing several grams of ammonium chloride at a pH of 0.8 to 1.4. After analysis of the precipitant, it was found that the gram molecular proportion of zirconium in the organic portion is in the ratio of 1:1. From this, it is concluded that the precipitant must be in the form of a zirconium salt of α-methoxy benzyl acetate. A method of obtaining precipitates is described that can be used to determine precipitants containing as low as 2.6 mg of zirconium. The thermoanalysis curve of the basic α-methoxy benzyl acetic acid zirconium salt does not resemble the zirconium salt of bitter almond acid (the latter has two plateaus—60° to 188° C and 820° to 960° C, while the former has only one plateau—815° to 910° C). P.V.E.

N64-20663 Joint Publications Research Service, Washington, D.C.
THE QUANTITATIVE TITRATION OF SELENIUM
Tsung-chi'i Tso, Hu-lin Li, and Kan-chien Sun *In its* Transl. on Communist China's Sci. and Technol., no. 82 May 1964 p 78–84 refs Transl. into ENGLISH from K'o-hsueh T'ung-pao (Peiping), no. 2, 1964 p 163–164 (See N64-20657 13-01) OTS: $2.25

A brief discussion is presented of research done in quantitative titration of selenium. Two methods are discussed, the first involving combining of selenious acid with excess potassium iodide to separate out the iodine and then titrating this solution with electrolytic antimonious ions, and the second involving the quantitative titration of selenium in copper anode mud. P.V.E.

N64-20678 Du Pont de Nemours (E. I.) and Co., Aiken, S.C.
A GAS CHROMATOGRAPH FOR DETERMINING O_2, N_2, NO, N_2O, SO_2, AND H_2S IN STEAM
David L. West Mar. 1964 16 p refs
(Contract AT(07-2)-1)
(DP-880) OTS: $0.50

A gas chromatograph was designed, assembled from existing components, and tested for the determination of O_2, N_2, NO, N_2O, SO_2, and H_2S in superheated steam. In a four-column arrangement, water was stripped from the sample by a polar partition column at 160° C, and then the remaining components were resolved by the other three columns at room temperature. A sample can be analyzed automatically in 20 minutes. The minimum detectable concentration was 0.1 vol % or less for all gases except H_2S, for which the minimum was 0.3 vol %. Author

N64-20698 Hanford Atomic Products Operation, Richland, Wash. Reactor and Fuels Lab.
EFFECT OF OXIDE DISSOLUTION AND HEAT TRANSFER ON THE CORROSION OF ALUMINUM FUEL CLADDING
D. R. Dickinson and R. J. Lobsinger Dec. 1963 20 p refs
(Contract AT(45-1)-1350)
(HW-77529)

In-reactor corrosion rates of aluminum-clad fuel elements in high-temperature deionized water are much higher than measured in isothermal out-of-reactor tests at the same pH and surface temperature. This discrepancy is explained in terms of oxide dissolution and heat transfer. In a nonisothermal in-reactor system, the temperature, and hence the solubility, of aluminum oxide corrosion product, is greater at the fuel-element surface than at the cooler portions of the primary loop. This results in significant dissolution of the protective aluminum oxide from the fuel element and a large increase in its corrosion rate. There was good agreement between calculated dissolution rates and measured corrosion rates. In addition to promoting dissolution, heat transfer also raises the cladding temperature and corrosion rate because of the temperature drop across the surface oxide film. Measurements of cladding temperature showed particularly high temperature drops in in-reactor tests at reduced pH where a heavy layer of crud (deposited iron oxides) was present on the fuel surface. Author

08 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; telemetry; tracking; and wave propagation. *For tracking stations see*: 10 Facilities, Research and Support. *For related information see*: 06 Auxiliary Systems; 09 Electronics; 15 Instrumentation and Photography; and 22 Navigation and Guidance.

N64-20014 Joint Publications Research Service, Washington, D.C.
DEVICE FOR CONTINUOUS RECORDING OF THE SIGNAL TO NOISE RATIO
G. I. Levitan and A. L. Peysikhman 8 May 1964 19 p refs
Transl. into ENGLISH from Elektrosvyaz' (Moscow), no. 3, Mar. 1964 p 5–16
(JPRS-24527; OTS-64-31232)

The design of devices with the outlet voltage determined by the signal-to-fluctuation input noise ratio is discussed. Two such devices are described in detail. Fundamental theoretical prerequisites are examined, as well as the results of experimental research performed with the frequency-manipulated signal. Certain recommendations are given for designing the circuits. Author

N64-20030 Georgia Inst. of Tech., Atlanta
COMMUNICATIONS INTERFERENCE REDUCTION STUDIES Final Report
D. W. Robertson Griffiss AFB, N.Y., RADC, Apr. 1964 107 p
(Contract AF 30(602)-2904)
(RADC-TDR-64-80; AD-438975; P-4540)

This report describes a series of suppression devices and techniques, which can be applied to existing receivers with a minimum of receiver modification. Devices are described that are effective in reducing cw as well as pulse interference. Frequency translation, outphasing, and switching techniques are examined. A discussion of UHF tunnel-diode amplifiers is also included. Author

N64-20034 Georgia Inst. of Tech., Atlanta Engineering Experiment Station
AUDIO PULSE CANCELLATION FILTER
J. R. Walsh Griffiss AFB, N.Y., RADC, Apr. 1964 24 p
(Contract AF 30(602)-2904)
(RADC-TDR-64-105; AD-438133)

An audio pulse cancellation filter is described. The device provides an interference suppression capability for certain cases of cochannel pulse interference in amplitude-modulated communication receivers such as the R361A. The circuit consists of an oscillator, which is phase locked to the fundamental component of an interfering pulse signal, and the necessary delay and pulse generators to provide the capability for adding this locally generated pulse to the audio output signal of the receiver so as to effect a reduction in the amplitude of the interfering pulse signal. Circuit details are discussed, and results of tests are presented. Author

N64-20114 Lincoln Lab., Mass. Inst. of Tech., Lexington
STRATEGY FOR A TWO-WAY FEED-BACK COMMUNICATION SYSTEM
F. G. Popp 5 Dec. 1963 44 p refs
(Contract AF 19(628)-500)
(ESD-TDR-63-593; AD-426203; Rept. 62G-6)

A two-way feedback system with information repeats is described with particular reference to continuous sequential decoding of the type originated by Wozencraft and extended by Fano. A tutorial exposition of round trip time considerations is followed by an outline of the logic and equipment design required for full implementation. Several examples of the operation of such a system are presented. Author

N64-20147 Rhode Island U., Kingston
OPTIMUM PARAMETERS FOR A CLASS OF SURFACE WAVE ANTENNAS
Julius Kane Mar. 1962 42 p refs
(Contract AF 19(604)-7983)
(Sci. Rept. 7983/2; AFCRL-62-187; AD-435678)

A mathematical analysis of a surface wave antenna of finite length was made. An approximate solution of a three-part boundary value problem was found and was used as a mathematical model of a class of two-dimensional surface wave antennas. A solution was found to a reduced wave equation. Analysis showed that various items of physical interest, such as gain radiation resistance, can be presented as elementary expressions. R.T.K.

N64-20153 Illinois U., Urbana Coordinated Science Lab.
DESIGN AND PERFORMANCE OF A POLARITY COINCIDENCE DETECTOR
M. Raether and D. Bitzer Aug. 1963 27 p refs
(Contract DA-36-039-TR-US-AMC-02208(E))
(R-178; AD-418173)

A synchronous detector based on the polarity coincidence principle has been constructed and tested. The theory of operation is discussed with special emphasis on the influence of correlation between samples and the influence of error sources. Details of the construction are presented, and test results are discussed. The present instrument works in the range of 20 cps to 20 kc and is capable of measuring signal-to-noise ratios as low as 10^{-4}. It has been in constant laboratory use for several months and has proven to be a very reliable tool for the synchronous measurement of small a.c. signals. Author

N64-20165 Emerson and Cuming, Inc., Canton, Mass.
DESIGN TECHNIQUES FOR STRUCTURALLY SUPPORTED RADOMES Interim Engineering Report No. 1, 27 Jan. 1964-27 Apr. 1964
Russell Stetson, Eino J. Luoma, and Samuel J. Mason (MIT)
1 May 1964 34 p
(Contract AF 33(615)-1376)
(AD-439407)

The problem of designing a structurally supported ceramic radome is considered electrically and mechanically. Plans for a computer program to predict electrical performance of a flat array of metal I-beams with ceramic window inserts are presented as a first step, with the understanding that curvature of the radome wall as a parameter will be introduced later if necessary. The electrical performance of this flat array is defined in terms of the variation of insertion phase and insertion loss of the flat array with incidence angle, polarization and physical dimensions of the array as normalized with respect to wavelength. Experimental data are presented of near-field exploration of insertion loss and insertion phase of unidirectional I-beam arrays. At 8.6 Gc, spacing between adjacent metal 1" I-beam members should be at least 5". A basis has been established for defining external loads on tangent ogive radomes. Application to pressure loads is clear, to thermal loads requires minor refinement. Spot manual calculations show formidable pressure loads at the nose but very sharp decrease on moving aft, and strong unbalanced lateral load leading to large bending moments, at nonzero angles-of-attack. Author

N64-20188* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TRANSISTORIZED VHF TRANSMITTER DESIGN FOR SPACECRAFT APPLICATIONS
Charles R. Somerlock Washington, NASA, May 1964 38 p refs
(NASA TN D-2104) OTS: $1.00

A sample design for a VHF telemetry transmitter using transistors throughout is discussed. Various problems and difficulties peculiar to the use of transistors for this purpose are discussed, and suggestions are made as aids to the inexperienced designer. The philosophy behind the designing of this type of circuit is presented, including a discussion of: oscillators, amplifiers, buffer amplifiers, and frequency multipliers. As an example, a transistor was designed that had the following initial requirements: efficiency—> 25%, weight—< 1 lb, temperature range—0° to 100° C, spurious emission—> 60 db below carrier, and output frequency—136.500 mc. The designed transmitter was built and tested, and the results compared favorably with the initial requirements. P.V.E.

N64-20273 RAND Corp., Santa Monica, Calif.
JOINT COST AND PRICE DISCRIMINATION: THE CASE OF COMMUNICATIONS SATELLITES
Leland L. Johnson Jul. 1963 32 p refs
(P-2753-1)

The nature of the conflict between establishing and operating international communications satellites and establishing and operating commercial domestic industries is examined. The economic factors of differing cost and price are stressed. A.W.

N64-20297 RAND Corp., Santa Monica, Calif.
A NOTE ON PERSISTING RADIO PROPAGATION EFFECTS AFTER HIGH-ALTITUDE NUCLEAR BURSTS
C. M. Cain Mar. 1964 12 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4037-PR; AD-438822)

Certain high-altitude nuclear bursts produce abnormal ionization in the atmosphere, which can affect radio propagation over a wide area for as long as 2 weeks after the burst, particularly in the LF and VLF regions. The effects are most pronounced and persistent at night. A general semiquantitative theoretical explanation of the observed effects is presented. It is of interest to those concerned with theoretical or systems applications of the large variety of effects of nuclear bursts on the lower ionosphere and on radio propagation. Author

N64-20311 Raytheon Co., Bedford, Mass. Space and Information Systems Div.
INVESTIGATION OF HF/VHF IONOSPHERIC WAVEGUIDANCE MODES Final Report, 1 May 1963-15 Mar. 1964
Pietro P. Lombardini, et al Wright-Patterson AFB, Ohio, AF Avionics Lab., 15 Mar. 1964 154 p refs
(Contract AF 33(657)-11432)
(BR-2893; AL-TDR-64-32; AD-436761)

CONTENTS:

1. THE PATH LOSSES IN THE ENDO-IONOSPHERIC WAVEGUIDANCE MODES Barbara M. Smith 15 Mar. 1964 p 86–109 refs (See N64-20312 13-08)

2. NUMERICAL COMPUTATIONS FOR THE SEARCH OF LONG RANGE RAYS INVOLVING CONVENTIONAL PROPAGATION MODES Barbara M. Smith 15 Mar. 1964 p 110–146 (See N64-20313 13-08)

N64-20312 Raytheon Co., Bedford, Mass. Space and Information Systems Div.
THE PATH LOSSES IN THE ENDO-IONOSPHERIC WAVEGUIDANCE MODES
Barbara M. Smith *In its* Invest. of HF/VHF Ionospheric Wave Guidance Modes 15 Mar. 1964 p 86–109 refs (See N64-20311 13-08)

The total path power loss of a 30-mc/s ray from South Dartmouth, Massachusetts, to Arcetri, Italy, was computed. The total power loss, neglecting losses due to absorption, was 3.5×10^{-14}. The power loss due to absorption was 1.18 db. I.v.L.

N64-20313 Raytheon Co., Bedford, Mass. Space and Information Systems Div.
NUMERICAL COMPUTATIONS FOR THE SEARCH OF LONG RANGE RAYS INVOLVING CONVENTIONAL PROPAGATION MODES
Barbara M. Smith *In its* Invest. of HF/VHF Ionospheric Wave Guidance Modes 15 Mar. 1964 p 110–146 (See N64-20311 13-08)

Numerical computations are presented for the search of long-range rays from South Dartmouth, Massachusetts, to Arcetri, Italy. The search was made for the Pedersen Ray and the Lombardini Mode. Data for the following parameters are given: (1) phase path, group path, and ray path; (2) radius; (3) colatitude; (4) longitude; (5) absorption; and (6) dispersion. I.v.L.

N64-20335 Army Signal Research and Development Lab., Fort Monmouth, N.J.
RADAR REFLECTION FROM A PLANETARY SURFACE DESCRIBED BY A COMPOSITE CORRELATION FUNCTION
Fred B. Daniels May 1963 17 p refs
(USAELRDL-TR-2314; AD-408198)

An earlier theoretical study of radar reflection from a rough planetary surface is extended to include the case where the surface correlation function consists of two or more components. When both large-scale and small-scale structures are simultaneously present, the latter may completely dominate

the autocorrelation function of the echo and thus render the former undetectable by cw methods. The large-scale structure may be detectable in the angular power spectrum obtained from very short pulses as a separate "pip" at the origin. Experimental confirmation for the lunar case is described. The effective radar gain of the surface derived by the methods of physical optics has a maximum value of unity leading to a minimum value of 3 for the dielectric constant of the surface. The spectrum of the surface fluctuations inferred from the wavelength-dependence of the surface slope has a gap for components having a scale of a few meters. Radar studies of larger-scale roughness by means of wavelengths longer than 10 meters would be rendered impossible by the terrestrial ionosphere. The shorter wavelengths demonstrate the existence of roughness having a scale of a few centimeters or tens of centimeters. Author

N64-20351 Radio Corp. of America, Moorestown, N.J. Missile and Surface Radar Div.
ELECTROMAGNETIC WAVE SCATTERING BY PLASMA SYSTEMS WITH APPLICATIONS TO THE RE-ENTRY PROGRAM. DOWN-RANGE ANTI-MISSILE MEASUREMENT PROGRAM (DAMP)
A. I. Carswell, J. Nuttall, and G. Paquette (RCA, Montreal) Dec. 1962 122 p refs
(Contract DA-36-034-ORD-3144 RD; ARPA Order 51)
(RCA-DTM-62-24; AD-295045)

This is a review of certain topics relevant to an understanding of radar returns from the plasma associated with reentry bodies. First is a summary of the interaction of electromagnetic waves with plasma, using the effective dielectric coefficient approach. Following is a discussion of the methods of calculating the scattering of electromagnetic waves from dielectric bodies of simple shapes, with particular emphasis on cylinders. Next there is a review of work on radar observations of meteor trails and a discussion of the problems arising in the tracking of a reentering body. The report closes with suggestions for future work in this field. An extensive list of references is included as a bibliography. The experimental results described are a part of an analytical program directed toward better understanding of the effects of plasma and wake on radar electromagnetic propagation. Author

N64-20353 Ohio State U. Research Foundation, Columbus Antenna Lab.
CALCULATION OF RADIATION PATTERN OF A GENERAL PARALLEL PLATE TEM WAVEGUIDE APERTURE Report 1394-11
Charles E. Ryan, Jr. and Roger C. Rudduck 31 Dec. 1963 38 p refs
(Contract AF 33(657)-7829)
(AD-433718)

The E-plane radiation pattern of a TEM parallel-plate waveguide having one plate "slipped" in relation to the other, was computed using the geometrical theory of diffraction. The solution is set up for a general angle between the edges of the waveguide plates and a general plate spacing. The patterns are calculated over 360° for some typical cases and are experimentally confirmed by measured patterns of a wide-angle, H-plane, sectoral horn. One of the most important applications is for parallel-plate geodesic Luneberg lenses. These lenses have circular slot apertures of which each element is a parallel-plate waveguide. The radiation pattern of a geodesic lens can be calculated by pattern multiplication of the basic pattern of a semicircular line source and the pattern of an element of the aperture. The basic pattern is determined by the basic lens design, whereas the element pattern is determined by the termination of the lens plates and the lens mounting. The element pattern is important in lens design because it determines the beam excitation of various mounting configurations and the effect on the pattern in a beam elevation positioning lens as the beam is positioned. Author

N64-20355 Michigan U., Ann Arbor Cooley Electronics Lab.
DERIVATION OF AEROSPACE ANTENNA COUPLING-FACTOR INTERFERENCE PREDICTION TECHNIQUES Final Report, Feb. 1, 1963-Feb. 1, 1964
P. J. Khan, W. R. De Hart, R. M. Kalafus, A. I. Simanyi, R. B. Harris et al Apr. 1964 92 p refs
(Contract AF 33(657)-8178)
(Rept. 4957-8-F; AD-438208)

This report describes the results of the extensive analysis and measurement of antenna-coupling factors. The purpose of these studies was to supply information essential to the adequate prediction of the interference between one electronic communication system and one or more other electronic communication systems. All antennas involved in these studies, with two exceptions, are flush-mounted antennas such as would often be utilized on aerospace vehicles of either manned or unmanned types. One exception is the study of the quarter-wave monopole erected perpendicularly to a common grounding surface. The coupling of a given type of antenna to a quarter-wave monopole supplies all of the information necessary to give the power coupling from one antenna to another of the same type. (In the selection of power coupling, both resonant and traveling-wave antennas are used.) In this way, information was obtained for spiral-to-spiral coupling. This information can also be used to obtain the coupling between two antennas of unlike types. The second nonflush-mounted antenna studied was the dielectric rod. The most complete coverage is given to the coupling from one rectangular slot to another. This coverage includes slots arranged in a cylindrical or spherical surface. Included in the appendices are: (1) the relation between coupling and mutual impedance; (2) the slot coupling theory; and (3) the derivation of square spiral fields. I.v.L

N64-20362 Michigan U., Ann Arbor Cooley Electronics Lab
THEORY OF SIGNAL DETECTABILITY: OBSERVATION-DECISION PROCEDURES Technical Report 136
T. G. Birdsall and R. A. Roberts Jan. 1964 175 p refs
(Contract Nonr-1224(36))
(Rept.-03674-4-T; AD-429220)

The observation-decision procedures studied include predetermined nonsequential procedures and the optimum (Bayes') sequential procedure, deferred decision. Included are examples with normal observation statistics. Approximations and bounds are derived for deferred-decision parameters. Comparisons are given between the various observation-decision procedures. The comparison of the optimum nonsequential procedure and deferred decision are roughly the following: if the available output signal-to-noise ratio that could be obtained is small (on the order of +4 db in $2E/N_0$), then sequential procedures consume about 60% as much time as nonsequential procedures, and the resultant error probabilities are approximately the same; if the available output signal-to-noise ratio is on the order of +10 db, then deferred decision and the optimum nonsequential procedure consume about the same amount of time with sequential procedures making fewer terminal-decision errors. Author

N64-20372 Lincoln Lab., Mass. Inst. of Tech., Lexington
SPACE COMMUNICATIONS Division 6 Quarterly Progress Report, 1 Dec. 1963-29 Feb. 1964

G. P. Dinneen et al 26 Mar. 1964 26 p
(Contract AF 19(628)-500)
(ESD-TDR-64-40; AD-434292)

The program status includes: (1) A modified version of the original switched-beam satellite antenna system is being designed for inclusion in a series of experimental satellites. (2) The K_u and X_L Haystack antenna feed systems, including the Clavin feed, the associated paraboloid, and the rotary joint, have been completed and evaluated. (3) The block-diagram design of the signal-processing equipment for the Lincoln experimental terminal (LET) is complete. (4) The effort devoted to the general area of communications signal design has been directed specifically toward the development of communications techniques that will be useful for both active and passive satellite links. (5) The West Ford belt experimental belt program has continued with radar measurements at both sites as well as bistatic CW west-to-east measurements. (6) A program of several satellite launches has been formulated. (7) Various signal-detection algorithms have been developed, and their performance has been evaluated in terms of mean square error. (8) A new basis-free way to study error-correcting codes has been provided. Also discussed are engineering efforts pertinent to LET and the communications research satellite; space-probe instrumentation for EOGO, Pioneer, Mariner C, and the gamma-ray telescope; and advanced and theoretical studies pertinent to varactor analysis, the modulated-frequency divider, the spinning-ball magnetometer, and passive stabilization schemes. I.v.L.

N64-20431 National Bureau of Standards, Boulder, Colo. Boulder Labs.
ATMOSPHERIC ERRORS IN MICROWAVE RANGE AND SHORT-BASELINE AZIMUTH MEASUREMENTS
M. C. Thompson, Jr., H. B. Janes, and D. Smith 28 Feb. 1964 57 p refs
(NBS-8231)

Propagation experiments were made at 9.4 Gc/s to study the atmospheric errors in microwave measurements of range and azimuth using a short-baseline phase measurement system. Estimates of atmospheric errors in range and azimuth were computed from data obtained on a 15.5-km path near Boulder, Colorado. The results indicate that rms azimuth errors are approximately proportional to the inverse of baseline length, for baselines up to 150 cm in length. A comparison was made of atmospheric errors obtained with two different antenna sizes. Although the latter data included some unwanted sensitivity to ambient temperature, they indicated a decrease in atmospheric errors with increasing antenna aperture size. The feasibility of using microwave phase data to accurately point an angle-measuring instrument is also discussed. Author

N64-20443 European Organization for Nuclear Research, Geneva (Switzerland) Proton Synchroton Machine Div.
A DISTRIBUTED MULTI-CHANNEL COMMUNICATIONS SYSTEM FOR FLEXIBLE REMOTE CONTROL AND TELEMETRY
B. Sagnell 17 Apr. 1964 85 p refs
(CERN-64-21)

This trunk–multiplex system relies on the use of a single, high-capacity trunk cable as a link between all pieces of equipment that require exchange of control information, and on selective multiplex circuits to establish the necessary number of independent communication paths between the appropriate points. These circuits are introduced between the data sources and the cable and can increase the message-handling capacity of the cable by several hundred times. Features that differentiate this system from other existing remote signaling systems are: (1) the principle of distributed construction, with both the transmitters and the receivers independent of common equipment and fully operational individually; (2) the frequency range, twice as high as any other known system; (3) the large number of channels, 10 to 20 times more than in any other on–off carrier systems; (4) the use of normal main cable as the common transmission link; and (5) the concept of integrated control components and multiplex circuits, allowing the assembly of control without mechanical work or wiring. I.v.L.

N64-20465 Aerospace Corp., El Segundo, Calif. Electronics Research Div.
ELECTRONICS PROGRAM: RADIO FREQUENCY INTERFERENCE AT ORBITAL ALTITUDES Semiannual Technical Report, 1 Jul.–31 Dec. 1963
K. H. Hurlbut and C. J. Zamites 20 Mar. 1964 25 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-33; TDR-269(4250-44)-1; AD-437329)

Investigation of radiofrequency interference (RFI) at orbital altitudes was initiated because of the lack of information and activity essential for future reliable communications in space. Increasing transmitting powers and crowded frequency bands account for RFI problems requiring solution. The RFI problem was studied and the design of monitoring instruments suitable for making in-space measurements of the electromagnetic environment was investigated. Laboratory development of a compact, lightweight receiving system in the 200 to 1,000 mc band was initiated. The receiving system will consist of an antenna array, a bank of interdigital bandpass filters, and 16 crystal video receivers. The results of tests on breadboard and prototype circuits have demonstrated the feasibility of this instrumentation concept. The first RFI monitor may be placed in orbit in late 1964. Author

N64-20496* Lincoln Lab., Mass. Inst. of Tech., Lexington
C-BAND RADAR-BEACON TRACKING FOR PROJECT MERCURY Paper 63-59
B. H. Labitt Repr. from IEEE Trans. Commun. and Electron., Nov. 1963 p 647–656 refs Presented at the IEEE Winter Gen. Meeting, New York, 27 Jan.–1 Feb. 1963
(Sponsored by NASA)

This is an analysis of the Mercury beacon-tracking capabilities. Calculations of signal strength to be expected for orbital flights were made. As a result of the marginal signal levels that were computed, a program of improvements was initiated. Suborbital flight-test data were reduced and compared with computed values. Also extrapolations were made to the orbital cases. As a result of the test data, specific recommendations regarding antenna coverage were made. Orbital flights with and without recommended antenna modifications were performed, which afforded a unique "before" and "after" comparison. IAA

N64-20497 Lincoln Lab., Mass. Inst. of Tech., Lexington
TRACKING PERFORMANCE OF THE MERCURY QUAD-HELIX ACQUISITION AID
J. G. Barry and G. F. Dalrymple Repr. from Commun. and Electron., Nov. 1963 p 657–663 refs Presented at the IEEE Winter Gen. Meeting, New York, 27 Jan.–1 Feb. 1963 (IEEE Paper 63-58)

Discussed is the telemetry-frequency direction finder used by Project Mercury as an acquisition aid for assisting narrow-beam radars to acquire the spacecraft, and in which the broad beamwidth of the quad-helix antenna allows multipath reception to degrade tracking accuracy at low elevation angles. Analyses of aircraft and spacecraft tracking results prove that

aircraft tests at close range are valid for evaluating orbital tracking performance. Aircraft acquisition tests show the ability of the equipment to place the AN/FPS-16 tracking radar on target. IAA

N64-20507 Cutler-Hammer, Inc., Deer Park, N.Y. Airborne Instruments Lab.
STUDY OF INTEGRITY, RELIABILITY, AND ACCURACY OF AUTOMATIC HEIGHT REPORTING SYSTEM VIA ATC RADAR BEACON SYSTEM, PHASES I AND II Final Report
Allan Ashley and Lanier G. Cole Sep. 1963 253 p refs
(Contract FAA/BRD-329)

Discussed are code degradation resulting from synchronous and random interference, and code-detection criteria. Analytical models include random and operationally controlled distributions of aircraft with emphasis on high-density areas. It is concluded that height data derived from this system will afford good integrity. Belief in the high code integrity of the automatic-altitude reporting system leads to the inquiry about the accuracy of the system or whether the task can be performed more efficiently by another type of radar equipment. The accuracy of various altimetry systems is statistically assessed in terms of maintaining vertical separation. ICAO analyses of altimeters are used as a basis of evaluation with modifications included for the parameters of the automatic reporting system. The statistical accuracy of altitude data derived from the automatic reporting system, with regard to the effect on vertical separation, is not significantly different from that of comparable existing altimetry; an extra margin of safety should be attained by providing the controller with a means to monitor the flight technical error. Also, data rate and capacity of the ATCRBS is equal to or greater than that of other systems that were considered. Author

N64-20511 RAND Corp., Santa Monica, Calif.
AIDS FOR THE GROSS DESIGN OF SATELLITE COMMUNICATION SYSTEMS
G. M. Northrop Aug. 1963 43 p refs
(P-2785)

A majority of the computational aids, such as charts and nomographs, that are applicable to the gross design of satellite communication systems are presented. Pertinent design equations are introduced and discussed briefly, with special emphasis placed on the limitations of the equations and ranges of the parameters. The utility of these computational aids is demonstrated in the solutions of some simple satellite-communication-system design and analysis problems. R.T.K.

N64-20528 Lincoln Lab., Mass. Inst. of Tech., Lexington
DELAY IN DATA TRANSMISSION THROUGH GENERAL NETWORKS Group Report 65G-7
B. J. Moriarty 18 Dec. 1963 58 p refs
(Contract AF 19(628)-500)
(AD-427258)

This report studies the delays due to link outages experienced in sending data through a communication network. Error-correcting techniques ensure that all data are effectively transmitted without error through a link, but are delayed when the link is not functioning correctly. One source of data and one link for data are assumed. A data handling logic is adopted at the nodes, which permits the use of all links (if desired) in a network. The use of redundant links to reduce delay has been investigated by means of a computer simulation program. The link behavior assumed for this program is obtained from measurements of two HF RTTY links. Theoretical approximations for delay are obtained that indicate the importance of the minimum cut set and minimum path length. Simulation results are in close accord with these approximations. Author

N64-20650 Weapons Research Establishment (Australia) Australian Defence Scientific Service
EXPECTED ERRORS OF "OPDOP" SYSTEMS AT RANGE E, WOOMERA
R. H. Evans Nov. 1963 46 p refs
(SAD-131)

Formulas were derived and programed on the IBM-7090 computer to obtain locational random errors for OPDOP systems. The errors were presented for many representative systems to illustrate their potential for trajectory computation and trial planning. OPDOP systems compare favorably with Contraves or Doppler systems alone. The magnitudes of expected total locational random errors, i.e., those inclusive of fix errors, for different OPDOP systems were presented in the form of contours of equal error in the central vertical plane at Range E, Woomera. Basic locational random errors, i.e., those exclusive of fix errors, are similarly presented for the same systems. Characteristics of OPDOP systems are demonstrated and discussed. Author

N64-20722 Compagnie Francaise Thomson-Houston, Paris (France)
TELEVISION INSTALLATIONS AT THE AIRPORT PARIS-ORLY [LES INSTALLATIONS DE TELEVISION DE L'AEROGARE DE PARIS-ORLY]
J. L. Delvaux Repr. from Rev. Tech. Compagn. Franc. Thomson-Houston (Paris), no. 40, May 1964 17 p In FRENCH

Orly Airport has been using a large installation of closed circuit television for the last three years. Five networks are at the Paris Airport Administration, two at Air France, and one at the Aérienne Navigation Service. These installations consist of 26 cameras and about 150 receivers, not counting the control receivers. They serve to disseminate information concerning meteorology, the movement of aircraft, etc.—either the surveillance of aircraft landings or of points of enplanement. Trans. by I.v.L.

09 ELECTRONICS

Includes circuits and circuit theory; electronic components (e.g., tunnel diodes, transistors, and tubes); and feedback and control theory. *For related information see*: 06 Auxiliary Systems; 08 Communications; 15 Instrumentation and Photography; 22 Navigation and Guidance; and 25 Physics, Solid-State.

N64-20022 Harvard U., Cambridge, Mass. Cruft Lab.
A STUDY OF THE SLOT TRANSMISSION LINE AND SLOT ANTENNAS. PT. 5: RADIATION FIELDS OF SLOT-YAGI ANTENNAS ON FINITE PLANAR AND CURVED SURFACES
Robert W. Burton 8 Nov. 1963 53 p
(Contract Nonr-1866(32))
(Tech. Rept. 427; AD-428779)

As a complement to the earlier reports published under the same general heading, this report discusses the results from observations of the far field of planar and curved slot arrays very similar to those upon which precise current and field distribution measurements were made. Of particular interest is the circular slot array formed by folding the slot

Yagi antenna back upon itself. This array is discussed in some detail, and some applications to communication systems of missiles and rockets are pointed out. Author

N64-20024 Monsanto Research Corp., Dayton, Ohio Dayton Lab.
HIGH TEMPERATURE THERMOELECTRIC RESEARCH Second Quarterly Progress Report, 31 Dec. 1963-3 Apr. 1964
C. M. Henderson et al [1964] 53 p
(Contract AF 33(615)-1084)
(AD-437280)

This report describes applied research to establish the technical feasibility of utilizing high temperature thermoelectric generators, powered with nuclear and solar heat sources, as long-lived power supplies for aerospace vehicles. A nominal 50-w laboratory generator, previously damaged by heating its intermediate junction between thermoelectric segments beyond 950° C, was repaired and subjected to renewed sustained testing at a hot-junction temperature of ~1,200° C in a vacuum of 10^{-5} to 10^{-6} torr. It completed 360-hr continuous testing at 1,200° C without apparent degradation of its power-generating characteristics; the test is continuing. An improved experimental model generator was designed, fabricated, and subjected to shakedown tests, prior to the start of sustained tests on the unit. Author

N64-20026 Litton Systems, Inc., Waltham, Mass.
DENSITY DISCRIMINATION FOR PRINTER UTILIZATION STUDY Final Report
A. Manevitz, J. L. Edie, and G. S. Sebestyen Griffiss AFB, N.Y., RADC, Apr. 1964 52 p
(Contract AF 30(602)-3064)
(RADC-TDR-64-37; AD-438418)

This report presents a summary of the work performed to study and investigate the capability of the Semi-Automatic Target Recognition Device (SATRD) for the determination of cloud cover on RADC supplied aerial reconnaissance film. Of 6 parameters used in this study, three were proved effective. Using only these 3 parameters, the percentage cloud cover was machine measured on 70% of the processed frames to an accuracy of 15%. In the remaining aerial photographs, dense (in the negative) water areas and distant terrain, as viewed through haze in oblique photography, were often misclassified as cloud area. Study of the results indicated that improvement would result from the installation of a logarithmic video amplifier and of a scanner tube with improved uniformity of light output and improved resolution. Author

N64-20027 Electronic Communications, Inc., Timonium, Md. Research Div.
TWO-DIMENSIONAL SELF-FOCUSING ARRAY ANTENNA MODEL Final Report
Griffiss AFB, N.Y., RADC, Mar. 1964 133 p refs
(Contract AF 30(602)-2930)
(RADC-TDR-64-40; AD-438972)

The design of the 64 element, 75λ by 75λ X-band model is described, together with the methods and equipment used in acquiring the test data. The extensive results obtained are summarized and evaluated with respect to estimated performances. The experimental program included a study of the relationship of target configurations and array antenna element arrangements to the operating characteristics of the self-focusing array. A brief study of the scattering from metal spheres in the presence of a converging wave front was also conducted. The measured results of the program are presented in the form of radiated field patterns. Author

N64-20031 Advanced Kinetics, Inc., Costa Mesa, Calif.
HIGH POWER MERCURY SWITCH Final Report
R. W. Waniek et al Griffiss AFB, N.Y., RADC, Apr. 1964 93 p refs
(Contract AF 30(602)-2916)
(RADC-TDR-64-97; AD-438254)

The most feasible methods for utilizing a mercury pool as the cathode of a high-voltage, high-current switching device were determined with the following results: (1) High voltage hold-off of 100 kv was achieved with a 0.8-in. electrode separation, without the aid of voltage grading electrodes. (2) A completely new concept in triggering produced a proven self-healing trigger mechanism that is extremely reliable and rugged, both physically and electrically. (3) An understanding of the processes controlling recovery of voltage hold-off capabilities produced the geometrical configuration with the fastest possible recovery time. (4) The best possible geometric configurations for fast-pulse-risetime mercury switches were determined. (5) The pulse repetition rates theoretically attainable in a high-power mercury switch were ascertained. (6) Disintegration of the anode and resulting mercury contamination is minimized by the trigger injection mechanism. (7) A semiempirical formula was developed that predicts the maximum electric field to which a mercury surface can be subjected and remain stable. Curves are presented that demonstrate the relationship between mercury pressure and temperature. R.T.K.

N64-20033 Georgia Inst. of Tech., Atlanta Engineering Experiment Station
ACTIVE NOTCH FILTER
Griffiss AFB, N.Y., RADC, Apr. 1964 56 p
(Contract AF 30(602)-2904)
(RADC-TDR-64-104; AD-438252)

This report describes the theory of operation and the construction of a device to reject cw interference. The device constitutes a tunable, single-frequency rejection filter, which uses a phase-locked oscillator to obtain a narrow rejection notch in the region of 455 kc. The notch response is obtained by cancelling the signal to be rejected with a locally generated signal of equal amplitude and opposite phase. Automatic phase and amplitude control of the cancellation signal permits the rejection notch to track slow frequency and amplitude changes in the signal being rejected. A notch width of less than 100 cps is obtained with tracking being maintained over a 10-kc bandwidth centered at 455 kc. Author

N64-20097 Radio Corp. of America, Harrison, N.J.
A 10-Mw, X-BAND TUNNEL-DIODE OSCILLATOR Second Quarterly Progress Report, 1 Oct.-31 Dec. 1963
E. Diamond, E. Casterline, R. Gold, and D. Nelson [1963] 36 p
(Contract DA-36-039-AMC-03195(E))
(AD-438192)

Tunnel diodes with peak currents of 50 ma, junction capacitances of 4 pF, and series resistances of 1.16 ohms, were tested in stripline circuits and gave 1.0 mw of RF power at 8.5 Gc. Theoretical calculations indicate that this is close to optimum performance. One hundred ma tunnel diodes were fabricated and power outputs of 2.0 mw were obtained at 6.5 Gc. The theoretical analysis indicates that with proper loading, it is possible to get 3.6 mw at 8.5 Gc. Optimum loading conditions for this type of diode are therefore being investigated. Author

N64-20099 Litton Industries, San Carlos, Calif. Electron Tube Div.
HIGH PERVEANCE GUN STUDY Quarterly Progress Report No. 10, 1 Sep. 1963-30 Nov. 1963

M. Hanley and A. Mizuhara Fort Monmouth, N.J., Army Electron. Res. and Develop. Labs., 4 Jan. 1964 16 p
(Contract DA-36-039-SC-87313)
(AD-438521)

The high-perveance gun-study includes the results of an investigation conducted in two areas. The first area involved experimental verification of the magnetic field plot that was derived from the computer studies and upon which the inverted magnetron injection gun design was based. A large discrepancy exists between the derived values and the experimental values of the magnetic field, due to an oversight in describing the boundary conditions of the magnetic field on the resistance network analog. This discrepancy required electrical redesign of the basic gun structure. The second area was concerned with finding a suitable magnetic field for a satisfactory inverted magnetron injection gun design to be made. Numerous magnetic field plots were obtained experimentally, resulting in a magnetic pole piece design, which can form a suitably diverging magnetic field when used with a solenoid. Despite the change in the electrical gun design, no changes in the klystron design objectives were made and the new gun will be designed to conform to previously established electrical characteristics. Author

N64-20119 ITT Federal Labs., Nutley, N.J.
VLF ENVELOPE TIMING EXPERIMENT Second Quarterly Progress Report, 8 Sep.-7 Dec. 1963
R. Aughey et al Dec. 1963 23 p refs
(Contract NObsr-89358)
(TD64-91; AD-435781)

The purpose of this project is to design, develop, and manufacture precision VLF envelope timing equipment, and to conduct experiments using this equipment to demonstrate the feasibility of time synchronization at separate geographical locations. The current project status includes: (1) The system design of the timing equipment has been finalized except for uncertainties in the exact method of local pulse generation. This area is presently being investigated in parallel approaches including passive circuit pulse shaping, linear video pulse generation and modulation, and independent receiver delay calibration using a sharply defined pulse directly into the receiver front end, or into the events pulse shaper-Model L (ESP-L) unit. (2) Four ESP-L units have been constructed. (3) A synthesizer to produce the 18-kc signal that is required for one approach to the local pulse generation problem has been breadboarded and tested satisfactorily. I.v.L.

N64-20127 Cutler-Hammer, Inc., Deer Park, N.Y. Airborne Instruments Lab.
FREQUENCY MULTIPLIER First Quarterly Progress Report, 1 Jul. 1963-30 Sep. 1963
J. J. Taub and G. P. Kurpis [1963] 56 p refs
(Contract DA-36-039-AMC-03196(E))
(AD-426765)

An analysis of the efficiency of varactor multipliers is discussed and related to the design of multimeter doublers. Varactor triplers and quadruplers, and the use of varistors, are considered and found to be less efficient than varactor doublers. The optimum drive level is discussed and is found to be a compromise between efficiency and frequency stability. An experimental 50 to 100 Gc doubler was designed and constructed. No 100-Gc output power was observed in a first test of the device. Experimental results on X- to K-band doublers are presented, and efficiencies of −10 db were measured. Author

N64-20130 Radio Corp. of America, Camden, N.J. Communications Systems Div.
LOW COST ARMY MICROMODULE PROGRAM First Quarterly Report, 1 Jul. 1963-30 Sep. 1963
P. Margolin [1963] 40 p
(Contract DA-36-039-AMC-03259(E))
(AD-439237)

The objective of this low cost module program is to establish design criteria for development of low cost linear and digital modular assemblies, which may incorporate monolithic silicon, thin films, multichips, or hybrids. The monolithic silicon device was chosen as the approach that has the highest potential for achieving a low cost Microrac functional assembly. A survey of digital devices manufactured by nine semiconductor companies was made; two vendors met Microrac requirements. The Microrac computer was studied; the timing level generator was selected as the functional assembly to serve as an exercise vehicle. Feasibility of the selected devices and techniques will be demonstrated using integrated circuit packages (ICP's) containing Fairchild Micrologic II elements. Where only flat packs are used, a new module assembly structure is proposed using 28 internal riser wires of which 20 are brought out of the module for connection on a printed circuit board. This module readily accepts these flat-pack ICP's which have modified lead frames. Monolithic silicon devices in flat rectangular parallelepiped packages with dimensions less than 0.250 in. × 0.060 in. were made compatible with riser wires of the module by positioning and shaping the external lead wires of the flat packages. Author

N64-20138 General Electric Co., Philadelphia, Pa.
SOLID ELECTROLYTE TANTALUM FOIL CAPACITOR Quarterly Research and Development Report, 28 Dec. 1963-27 Mar. 1964
A. L. Jenny [1964] 41 p
(Contract NObsr-89380)
(AD-436726)

The program status includes: (1) A purity check was made to screen materials for the preparation of plain Ta foil samples rated 150 VDC at 85° C. The tests used as criteria for the choice of material included wet leakage current at 400 VDC and 25° C, dielectric absorption, and voltage breakdown in dilute HNO_3 in the presence of MnO_2. A foil material was selected on the basis of these test results. (2) Iron was found to be a possible contaminant in the etch electrolyte. (3) The breakdown voltage of etched foil samples was determined as a function of etching electrolyte composition, water content, and time of etching. (4) Etched samples were vacuum heat treated for short times at 2,150° C and for longer times at 1,850° C; the results were compared to unannealed and unetched foil. (5) There appears to be no significant correlation between breakdown voltage and the impurity content of MnO_2/Ta_2O_5 foil samples. (6) Evidence thus far with prototype devices of 1 to 10uf using plain foil shows that the solid-state device has only 70% to 85% of the theoretical wet capacitance. Also, experiments in progress, or planned, to assist in establishing the process to be used in building the capacitors are discussed. I.v.L.

N64-20142 Struthers-Dunn, Inc., Pitman, N.J. Engineering Test Labs.
FABRICATION AND ACCEPTANCE TESTING OF POWER RELAY STRUCTURE Final Report
Geraldine E. Mease 28 Jan. 1964 227 p
(Contract DA-36-039-SC-73213)
(Rept. 2551-A; AD-435882)

A summary is presented of tests conducted on miniature, double-pole, double-throw, power relays. The tests were conducted to establish their potential performance and to provide the data to establish life expectancy as a function of the parameters under investigation. Tests were also conducted to measure and/or determine contact resistance, operating characteristics, coil resistance, insulation resistance, dielectric strength, operate and release time, leakage rate of seals, vibration and shock resistance, effects of acceleration, volatility of materials, high and low temperature characteristics, contact overload, and lifetime. P.V.E.

N64-20169 Norwegian Defence Research Establishment, Kjeller

RESEARCH ON THE THEORY AND DESIGN OF ACTIVE NETWORKS Annual Summary Report No. 2, 1 Apr. 1962-30 Jun. 1963

Tor Schaug-Pettersen Jul. 1963 6 p refs

(Contract AF 61(052)-484)

(NDRE-142/176; AFCRL-63-571; AD-426446)

Investigations of network transformation theory were undertaken. Among the topics studies were: transformations of a generalized network, lossless transducer transformations, and properties of inert networks. Active networks containing solid-state components were also investigated. A discussion is also presented of: the generation of subharmonics by means of varactor diodes, nonlinear oscillations in a tunnel diode, noise figure of a phonon amplifier, and RF generation in piezoelectric semiconductors. R.T.K.

N64-20185 Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.

PRODUCTION DEVELOPMENT OF A SILICON PLANAR EPITAXIAL TRANSISTOR WITH A MAXIMUM OPERATING FAILURE RATE OF 0.001% PER 1000 HOURS AT A CONFIDENCE LEVEL OF 90% AT 25°C Sixth Quarterly Report, 1 Aug. 1963-31 Oct. 1963

Paul Greer [1963] 47 p

(Contract DA-36-039-SC-86728)

(AD-437946)

This report contains the results of the efforts expended in the reliability improvement program. Final large scale tests of Al-Al-Au metallization process devices are described, and the results are compared with previous test results. Parameter distributions and stability during operating and storage life tests are discussed, as well as comparative failure rates and mechanical ruggedness. An estimate of the failure rate achieved on this program for the Motorola 2N2219 is presented. Author

N64-20213 Joint Publications Research Service, Washington, D.C.

DEVICE FOR THE SHAPING OF SQUARE PULSES FROM ELECTRIC SIGNALS OF ARBITRARY FORM OF SUBSONIC FREQUENCIES

I. I. Prudovskiy and N. S. Yalynychev *In its* Turbulent Diffusion in the Surface Layer of the Earth's Atmosphere 6 May 1964 p187-192 refs (See N64-20201 13-21) OTS: $5.00

A system is presented for shaping into standardized square pulses electrical signals of great duration with gently sloping fronts. These signals arrive from a data unit with a frequency practically from 0 cps and more. The basis of the shaping device is the trigger circuit with cathode coupling. The circuits considered were used as shaping cascades of scaling units for the shaping of signals from a photoelectric data unit. Laboratory and field tests of the circuits gave satisfactory results. The devices shape square pulses with a steepness of front on the order of several microseconds and an amplitude from electrical signals of subsonic frequencies of practically any form. C.L.W.

N64-20221 Joint Publications Research Service, Washington, D.C.

A SEMICONDUCTOR VARIANT OF THE INTEGRAL FLUCTUATION METER

S. M. Gershteyn *In its* Turbulent Diffusion in the Surface Layer of the Earth's Atmosphere 6 May 1964 p 254-258 (See N64-20201 13-21) OTS: $5.00

A semiconductor variant of the circuit of an integral fluctuation meter is described. The conversion of the angle of rotation of the wind direction sensor into an electric value is accomplished by a selsyn whose rotor is attached rigidly to the sensor. A supply voltage is fed to the three-phase winding of the selsyn. The useful signal is the phase shift between the voltage on the single-phase winding of the selsyn and the voltage of one of the current phases that is used as a reference voltage. The basic circuit of the semiconductor variant of the integral fluctuation meter is included. R.T.K.

N64-20245 Atomics International, Canoga Park, Calif.

A TEST VEHICLE PROTECTION CIRCUIT

E. L. Gardner *In* Defense Dept. Shock, Vibration and Assoc. Environ., Pt. 3 Mar. 1964 p 79-80 This paper was not presented at the symp. (See N64-20235 13-01)

The protection circuit described can respond to an excessive signal in a few milliseconds. It is easy to calibrate and has a reset means that does not override the cutoff circuit. It has its own power supply and is independent of the driver signal servosystem, except that it feeds into the signal circuit ahead of the master gain control. Usually two or more of these circuits are used at one time. The reset method of the circuit is unique. When the reset switch is actuated, the conduction of the silicon controlled rectifier (SCR) is stopped by bypassing the relay current to ground. Since there is no signal from the test specimen at this time, the SCR is reset; but the relay still holds the driver input signal circuit open and continues to do so until the reset switch is released. If the master gain control has not been set to a reduced level, the safety action recurs immediately. By resetting in this manner, the safety circuit cannot be overridden; the drive signal passes through the power on-off switch and is interrupted if the safety circuit power is turned off. A schematic diagram of the protection circuit is included. R.T.K.

N64-20272 Technical Research Group, Inc., Menlo Park, Calif.

DEVELOPMENT AND TESTING OF HF WIRE-GRID LENS ANTENNA, VOLUME I Final Report

R. L. Tanner, E. M. T. Jones, M. G. Andreasen, and E. D. Sharp Mar. 1964 138 p refs

(Contract ARDS-598)

(RD-64-33)

An HF lens antenna has been built. The lens employs a novel focusing medium consisting of two wire grids, one above the other, whose wave slowing or refractive characteristics are to first order independent of frequency. This property makes the lens inherently capable of operation over very wide bandwidths. The basic refractive profile and circularly symmetric form of the lens are similar to the well-known Luneburg lens. As a consequence, the HF wire-grid lens is in focus for waves arriving from any azimuthal direction. Pattern measurements have been made on the completed full-scale antenna using a ground-based transmitter. The results of these tests indicate that, within the limits of experimental accuracy, the lens antenna is performing according to predictions both from the standpoint of radiation patterns and in respect to operational advantages over other types of HF antennas. Author

N64-20300 Lincoln Lab., Mass. Inst. of Tech., Lexington
RADAR Quarterly Progress Report, 1 Dec. 1963-29 Feb. 1964
J. Freedman and H. G. Weiss 27 Mar. 1964 22 p refs
(Contract AF 19(628)-500)
(ESD-TDR-64-41; AD-435689)

Research effort was concentrated in the following areas: array radar, low-noise receiver, and 8-mm radar programs. Progress on the Haystack Hill Program is also reported. R.T.K.

N64-20314 Naval Postgraduate School, Monterey, Calif.
OPTIMIZING FOR MINIMUM RESPONSE TIME IN A LINEAR SYSTEM WITH LIMITED CONTROL EFFORT
James S. Demetry and Harold A. Titus Apr. 1964 23 p refs
(Res. Paper-45; AD-439262)

Integral indices of performance are brought to bear on the problem of minimizing step response time in some simple control systems. This minimization is subject to a bound on the total control effort that may be expended in response to a step command. Special attention is given to an index whose integrand is a form of the Euclidean norm of the system's states. An example is given showing, for a given system, the development of a weighting scheme for the second term in a two-term index of performance. Author

N64-20334 Army Signal Research and Development Lab., Fort Monmouth, N.J.
BULK RELIABILITY EFFECTS IN SEMICONDUCTOR DEVICES; CURRENT CROWDING IN TRANSISTORS
Bernard Reich and Edward B. Hakim Feb. 1963 18 p refs
(USAELRDL-TR-2333; AD-408131)

The problem of current crowding in transistors is reviewed and its relationship to transistor performance described. A method is described whereby a quantitative value can be assigned as a measure of the extent of crowding that occurs. The possible implications of current crowding in the operational reliability are described. An empirical figure of merit is developed relating the crowding factor to the physical parameters of the semiconductor device. Recommendations in device design are made, which should improve the current handling capability of transistors. Author

N64-20357 Ohio State U. Research Foundation, Columbus Antenna Lab.
GEODESIC LENS FEEDS AND FLUSH-MOUNTED MULTIPLE FEED PERFORMANCE IN A GEODESIC LENS
R. B. Dybdal, R. C. Rudduck, and C. E. Ryan, Jr. 31 Dec. 1963 45 p refs
(Contract AF 33(657)-7829)
(Rept.-1394-12; AD-435632)

Feeds for circularly symmetric geodesic lens antennas were investigated. These high-gain microwave antennas are constructed of two contoured parallel metal plates between which energy propagates in the TEM waveguide mode. Energy is launched between the lens plates by feeds either inserted between the plates or mounted flush to one of the plates. The multiple beam capability of an X-band geodesic lens model employing multiple fixed feeds of the narrow flush feed type was experimentally determined. These feeds have narrow width compared to conventional rectangular waveguide so that close beam overlap can be achieved. Simultaneous coverage over sectors on the order of 130° about the lens axis can be achieved with these feeds. Larger sectors up to 360° may be obtained if appropriate switching of feeds was used. Coupling measurements indicated that simultaneous transmit-receive operation is not practical with a single lens and time-sharing is required. Author

N64-20384 Lear Siegler, Inc., Grand Rapids, Mich. Instrumentation Div.
DEVELOPMENT OF A SOLID-STATE DISPLAY DEVICE Technical Documentary Report, Mar. 1961-Feb. 1963
G. L. Van Winkle, R. Schulmeyer, and E. Frein Wright-Patterson AFB, Ohio, Research and Technol. Div., Mar. 1964 91 p refs
(Contract AF 33(616)-7905)
(RTD-TDR-63-4163; AD-438029)

Discussed is the development of a solid-state display device utilizing binary inputs. Investigation of various techniques for decoding the binary inputs led to the development of an electroluminescent-photoconductor matrix. Readout is provided by a column of light moving up and down a vertical scale. The column of light is formed by a stack of 1/16-in. electroluminescent lamps spaced 1/32-in. apart. The display produced under this contract provides a readout from 0v to 31v on a scale approximately 3-in. long. Author

N64-20402 Radiation Inc., Melbourne, Fla. Antenna and Microwave Engineering Section
STUDY OF SPECIAL BEAMSHAPING ANTENNAS Second Quarterly Report, 1 Oct. 1963-31 Dec. 1963
R. E. Moseley, B. L. Lewis, L. Pietsch, Homer E. Bartlett, and G. W. Collins [1963] 69 p refs
(Contract DA-36-039-AMC-03310(E))
(AD-429052)

This report describes the theoretical and experimental investigations on the applicability of end-fire dielectric elements in easily transportable satellite communications antenna arrays and in primary feed systems. Ray-tracing theory has resulted in a simple new concept that explains the optimum length criterion for end-fire antennas. The requisite characteristics for optimum exciters for dielectric waveguides have also been derived. This theory has led to the conception of a new type of antenna, the three-dimensional zone plate. A foamrod antenna, which provides the highest gain and lowest sidelobes ever achieved with a single end-fire element, is described. The resulting gain and maximum sidelobe level are 35 db and −23 db, respectively. The feasibility of producing a high-gain dielectric tube antenna has also been demonstrated. Author

N64-20404 Illinois U., Urbana Engineering Experiment Station
MEGAVOLT ELECTRONICS, SUB-MILLIMETER WAVE RESEARCH Annual Report No. 4 [1 Sep. 1962-31 Aug. 1963]
M. D. Sirkis, J. R. Baird, F. J. Rosenbaum, R. G. Heeren, W. E. Kunz et al Dec. 1963 153 p refs
(Contract AF 33(657)-10224)
(RTD-TDR-63-4212; AD-428806)

Generation of millimeter wavelength radiation by means of the Doppler effect is discussed. In contrast to other rebatron experiments, the output frequency need not be a harmonic of the rebatron frequency and is therefore potentially tunable. Power has been generated at 39.7 Gc at the milliwatt level in substantial agreement with theory. An approximate method for calculating parameters appearing in the study of the propagation of Cerenkov radiation in anisotropic ferrites is presented. Theoretical studies of transition radiation in both stratified media and in waveguides are described. Numerical evaluation for the waveguide problem leads to interaction resistances of the order of 10 to 100 ohms. Information concerning the construction of the 35 Gc rebatron, now ready for initial testing, is presented. Author

N64-20439 Conductron Corp., Ann Arbor, Mich.
NEW VOR COUNTERPOISE SYSTEM FOR REDUCTION OF SITING ERRORS Final Report

V. H. Weston, J. E. Clark, and F. M. Penar Jan. 1964 66 p refs
(Contract FA-WA-4665)
(RD-64-47)

Single-loop and multiple-loop counterpoise systems were investigated. It was concluded that: (1) Single loop above a counterpoise radiation pattern can be calculated and measured at a scaled frequency of 3.02 kmc for a 52-ft- and 150-ft-diameter counterpoise and appropriate loop heights above the counterpoise. (2) Multiple-loop stacked array radiation patterns can be computed by a simple extension of the single-loop theory. (3) Significant improvement in free-space field patterns can be obtained by using a multiple-loop array. (4) Higher ratios of field strength above the counterpoise to below it are attainable, thus increasing the field gradient along the horizon. R.T.K.

N64-20510 National Science Foundation, Green Bank, W. Va. Electronics Div.
APPLICATION OF THE ANTENNA TOLERANCE THEORY TO THE NRAO 85-FOOT AND 300-FOOT TELESCOPES Internal Report No. 17
P. G. Mezger Aug. 1963 27 p refs

Two kinds of errors in parabolic antennas are discussed: (1) defocusing of the primary feed; and (2) random deviations of the parabolic reflector from an ideal paraboloid. A short review of the tolerance theory of paraboloid antennas is included. Results of a photogrammetric calibration of the 85-foot and of the 300-foot telescopes are presented, and a comparison is made between theory and experimental results. R.T.K.

N64-20539 Ohio State U. Research Foundation, Columbus Antenna Lab.
RESEARCH ON THE APPLICATION OF THE LUNEBERG LENS TO ECM ANTENNA SYSTEMS Final Engineering Report, 1 Dec. 1961-30 Nov. 1963
31 Dec. 1963 69 p refs
(Contract AF 33(657)-7829)
(Rept. 1394-13; AD-433780)

This report describes research on a class of circularly symmetric geodesic lenses. The purpose of the investigation is the determination of the capabilities and limitations of this type of lens as a high-gain microwave antenna with rapid scanning of beams or simultaneous coverage with multiple beams. Methods of calculating radiation patterns are given, and the concept of element pattern can be used to describe lens aperture effects. A method of beam elevation positioning that gives control of beams in directions transverse to those possible due to lens symmetry is investigated. Two independent polarizations are obtained by use of TEM and TE_{01} waveguide modes. Feeds of various types and the multiple beam capability of these lenses are investigated. Author

N64-20542 STELMA, Inc., Stamford, Conn.
DEVELOPMENT OF ELECTRICAL SYNCHRONIZER SN-293( )/G Third Quarterly Progress Report, 1 May 1963-31 Jan. 1964
B. Yellen 1964 16 p
(Contract DA-36-039-SC-88946)
(AD-437150)

Development of a general-purpose synchronizer provides cryptographically secure synchronous operation between FIELDATA equipments and telegraph terminals AN/FGC-29, AN/TCC-30, and AN/TCC-4. The report describes work performed toward: (1) incorporating—into the equipment—the mechanical-design recommendations submitted by the Signal Corps in completion of the evaluation tests performed on the preliminary service test model; and (2) preparation for production of the five service test models to be submitted. No electrical design modification was necessary, the test revealing that equipment performance met or exceeded specification requirements. Manufacture of the service test models is proceeding on schedule; production, testing, and final delivery are to be completed. Author

N64-20571 Michigan U., Ann Arbor Cooley Electronics Lab.
STUDY AND INVESTIGATION OF A UHF-VHF ANTENNA Bimonthly Report No. 7, Jan. 2, 1964-Mar. 2, 1964
J. E. Herman and S. B. Rhee Mar. 1964 8 p ref
(Contract AF 33(657)-10607)
(Rept.-5549-7-P; AD-437193)

A comparison of theoretical and experimental beam patterns for the equiangular spiral will be available shortly. Preliminary tests of magnetic bias on the ferrite-filled rectangular slot indicate that the resonant frequency of the slot increases with increasing magnetic fields. Further tests of the effects of ferrite loading on VSWR and beam pattern for the log conical and log zig-zag antennas are being conducted. An extension of the frequency range of the antennas is indicated. Author

N64-20620 European Organization for Nuclear Research, Geneva (Switzerland)
MATCHING OF THE WAVEGUIDE COUPLER FOR THE RF SEPARATOR DEFLECTING STRUCTURE
P. Bramham and M. J. G. Lee 21 Feb. 1964 20 p refs
(CERN-64-14)

RF energy is introduced into the disc-loaded deflecting structure by means of a coupler, consisting of a waveguide mode transformer. In the absence of a well-matched terminating impedance for the disc-loaded waveguide, an approximately matched absorber was moved along inside it. This made it possible to plot the input admittance of the coupler corresponding to matched output conditions. Definitive couplers were matched by machining certain dimensions in stages and observing changes in the Smith chart plot. Author

N64-20686* Electronic Communications, Inc., Timonium, Md. Research Div.
ANTENNA PATTERN RANGE TEST EQUIPMENT Final Technical Report
D. A. Youngberg and H. J. Peters 15 Apr. 1964 48 p
(NASA Contract NAS8-11521)
(NASA CR-56099) OTS: $4.60 ph

The test set is a high-resolution, bistatic radar operating at S-band. The range of a reflection is given by the time delay between the direct path pulse and the reflected pulses. The equipment is capable of detecting reflections from distances of 4 ft to 150 ft relative to the direct path. The test set contains six units and cabling for installation. Author

10 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands and wind tunnels); test ranges; and tracking stations. *For related information see*: 06 Auxiliary Systems.

N64-20151 Air Force Systems Command, Edwards AFB, Calif. Air Force Flight Test Center
AFFTC TEST FACILITIES HANDBOOK
[1963] 291 p
(FTC-TIH-63-2003; AD-435024)

This handbook is designed to provide information concerning the Air Force Flight Test Center, its mission and support capabilities, and the procedures by which these are provided. Also given is a summary of the Center's capabilities. The AFFTC's origin, mission, concept of operations, general policies, and official relationships, as well as the conditions that govern or apply at the Center are presented. The technical and support services provided by AFFTC are enumerated. Information is included on how to obtain these services. R.T.K.

N64-20178 Bell Helicopter Co., Fort Worth, Tex.
JOINT ARMY-NAVY AIRCRAFT INSTRUMENTATION RESEARCH: TELEVISION AS AN AID TO HELICOPTER FLIGHT
C. B. Elam Mar. 1964 59 p refs
(Contract Nonr 1670(00))
(D228-421-018; AD-437975)

Evaluation was made of the pilot's ability to land, takeoff, hover, and navigate a helicopter using television for visual contact with the ground. The effects of two experimental variables were investigated. These were the position of the forward looking TV camera (on the landing skid as compared to being at the pilot's eye level) and camera movement (fixed as against movable in pitch). Evaluation of the operations was also made under VFR as a control procedure. Measurement was made of airspeed, altitude, heading fore–aft, and lateral position errors. In general, the TV condition did not compare favorably with the VFR situation in precision of control, but the operations were usually successful and always safe. It was found that camera mobility facilitated the landings but was of less consequence for the other operations. It was concluded that TV, although useful, will not prove completely adequate for night flights. Author

N64-20189* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
RESPONSE OF A JET TRAINER AIRCRAFT TO ROUGHNESS OF THREE RUNWAYS
Garland J. Morris Washington, NASA, May 1964 23 p refs
(NASA TN D-2203) OTS: $0.50

An investigation was conducted to determine the acceleration response of a jet trainer, and to correlate runway roughness with the response. Acceleration data were obtained during taxi runs at constant speed on three runways having different roughness characteristics. In general, airplane acceleration increased with speed for the three runways and was higher at the nose than at the center of gravity. Direction of taxiing had no significant effect on the acceleration response. Pilot opinion of the relative roughness of the runways was in agreement with airplane-acceleration-response measurements. Airplane response and runway spectra were in general agreement in that the lowest response was measured on the runway indicated by the profile spectra to be smoother than the other two. However, the runway spectra did not provide a good indication of the relative response of the airplane on the other two runways for which the spectra showed only a small difference in roughness. Airplane transfer functions, computed as the ratio of the output acceleration spectra to the input runway spectra, varied significantly between repeated runs for similar test conditions. Author

N64-20247 Lockheed-California Co., Burbank
SIMULATING FLIGHT ENVIRONMENT SHOCK ON AN ELECTRODYNAMIC SHAKER
G. W. Painter and H. J. Parry *In* Defense Dept. Shock, Vibration and Assoc. Environ., Pt. 3 Mar. 1964 p 85–96 refs (See N64-20235 13-01)

A program to develop a method to produce oscillatory acceleration transients with adjustable shock spectra is described. Using this method, a wide range of pulse conditions can be accommodated including an "average" or "data envelope" type pulse. The equipment used and some results of the experimental program to date are discussed. Author

N64-20250 Navy Electronics Lab., San Diego, Calif.
FLEXURE STABILIZATION OF A REACTION VIBRATION MACHINE
R. H. Chalmers, Jr. *In* Defense Dept. Shock, Vibration and Assoc. Environ., Pt. 3 Mar. 1964 p 107–108 (See N64-20235 13-01)

This paper describes a method of restraining reaction vibration machines to planar simple harmonic motion even though test loads represent an appreciable percentage of the moving weight and exhibit severe resonances or isolation. Author

N64-20251 McDonnell Aircraft Corp., St. Louis, Mo.
AN ALTERNATE METHOD OF EXCITER SYSTEM EQUALIZATION
D. Scholz *In* Defense Dept. Shock, Vibration and Assoc. Environ., Pt. 3 Mar. 1964 p 109–112 (See N64-20235 13-01)

A remote equalizer-analyzer system is adjusted to the inverse of the mechanical characteristics of the unequalized test setup by means of a prerecorded tape signal. A taped input containing the desired test spectrum is then played through the system. The output is the equalized spectrum. Author

N64-20253 Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
SIMULATION OF REVERBERANT ACOUSTIC TESTING BY A VIBRATION SHAKER
D. U. Noiseux *In* Defense Dept. Shock, Vibration and Assoc. Environ., Pt. 3 Mar. 1964 p 125–136 refs (See N64-20235 13-01)

Random noise testing of structures having a linear response can be simulated by a mechanical shaker. A low-level acoustic test while monitoring vibration at a few critical points may be conducted and then the structure may be excited with mechanical shakers at higher vibration levels to simulate proportionally higher acoustic levels. The need of a low-level sonic excitation may be removed by measuring the radiation impedance of the structure, its mode density, and monitoring the mechanical power applied to the structure by a shaker. Experimental results, using the second approach, are presented. A closed box with an internal panel is suspended in a reverberant room excited by bands of random noise. The pressure levels in the room are measured together with the vibration level of different points of the box. Comparison of the experimental results for acoustical and mechanical excitation with calculations derived from available theory show encouraging agreement. Extensions and limitations of this technique are discussed. Author

N64-20255 Ling-Temco-Vought, Inc., Dallas, Tex. Military Electronics Div.
COMBINING INDUCTION HEATERS WITH EXISTING ENVIRONMENTAL FACILITIES TO CONDUCT TESTS AT REENTRY TEMPERATURES

C. D. Robbins and E. L. Mulcahy *In* Defense Dept. Shock, Vibration and Assoc. Environ., Pt. 3 Mar. 1964 p 141–147 refs (See N64-20235 13-01)

Amplifiers designed to drive electrodynamic vibration exciters can be used to power induction heaters. Both history and theory of operation of the induction heater are presented. Design parameters of efficiency, skin effect, hysteresis, temperature gradients, insulation, and safety are briefly discussed. Details are presented on susceptor technique, induction coil design, utilization of existing amplifiers to excite the coil, and illustrations of actual tests. Author

N64-20256 Navy Electronics Lab., San Diego, Calif.
THE NEL EXPERIMENTAL VIBRATION TEST STAND FOR USE IN CHAMBERS
A. A. Arnold *In* Defense Dept. Shock, Vibration and Assoc. Environ., Pt. 3 Mar. 1964 p 149–151 This paper was not presented at the symp. (See N64-20235 13-01)

The experimental vibration test stand for use in environmental chambers will enable reliability engineers to investigate the effects of combined environments on equipment failure rates. It provides for the type of vibration designated for AGREE (Advisory Group on the Reliability of Electronic Equipment) testing except that it goes beyond the nominal levels of the AGREE tests by allowing for variable accelerations up to 5.00 g (in the 20- to 33-cps range) combined with temperatures from minus 65° to plus 200° F at relative humidities ranging up to 95 percent. The test stand described was intended to be used in the vibration testing of two or more small electronic equipments such as small radio transmitters, receivers, and the like, simultaneously, while the equipments are experiencing extremes of temperature and humidity. Author

N64-20257 Ling-Temco-Vought, Inc., Dallas, Tex. Military Electronics Div.
A TECHNIQUE FOR PERFORMING VIBRATION TESTS AT HIGH TEMPERATURE IN EXCESS OF 3500°F
C. F. Hanes and R. W. Fodge *In* Defense Dept. Shock, Vibration and Assoc. Environ., Pt. 3 Mar. 1964 p 153–158 (See N64-20235 13-01)

This paper presents the application of a propane-fueled furnace as a heat source in conducting high-temperature vibration tests. The methods of applying heat to a test article while conducting random vibration tests are discussed, as well as instrumentation and cooling problems. Author

N64-20410 RAND Corp., Santa Monica, Calif.
PERFORMANCE OF LAND TRANSPORTATION VEHICLES
R. H. Haase and W. H. T. Holden Jan. 1964 151 p refs
(RM-3966-RC)

This study discusses the development of analytical techniques for evaluating transportation systems. The performance of land transportation systems and the derived equations of motion are based on an analysis of vehicle-propulsion system combinations. Equations of motion for vehicle-propulsion system combinations are developed by considering the movement of a land transportation vehicle as linear motion of a rigid body. The formulations provide an analytical procedure for estimating the effects of acceleration, maximum speed, coasting and braking rates, stop intervals, and stop duration on effective speed, headway, and route capacity of land transportation systems. An analysis and summary of published information on vehicle resistance and on propulsion force generated by various types of energy conversion systems are included. Also presented are acceleration speed-time curves for vehicle-propulsion system combinations, and equations of motion derived for a typical trip composed of four phases: accelerating, decelerating, traveling at constant velocity, and remaining stationary. R.T.K.

N64-20411 California U., Los Angeles Biotechnology Lab.
PERFORMANCE STUDIES ON THE NOTS-UCLA TRACKING SIMULATOR: EFFECTS OF ERROR MAGNIFICATION, FIELD OF VIEW, PROPRIOCEPTIVE CUES AND CONTROL DYNAMICS Technical Report No. 20
David R. Garfinkle, Russell L. Smith, Hilde Groth and John Lyman Apr. 1963 68 p refs
(Contract N123(60530)23558A)
(Rept. 63-41; AD-428183)

Experiments were performed on the NOTS-UCLA Tracking Simulator to assess effects of field of view and error-magnification proprioceptive cues and displacement aiding on tracking performance. Performance effects due to trajectory characteristics, trajectory direction, and tracking dimension were also analyzed. Particular attention was paid to individual differences and interactions between the chosen variables. The results showed: (1) that an error magnification by a factor of five significantly decreases tracking error compared to tracking without error magnification; (2) that proprioceptive cues related to both azimuth and elevation significantly improved tracking performance; (3) that the displacement aiding control dynamics produced better tracking scores than unaided velocity control dynamics. Individual differences in performance remained fairly consistent over all experimental conditions. The better trackers were consistently superior and showed less decrement on the more difficult tasks than the poorer trackers. Author

N64-20446 Massachusetts Inst. of Tech., Cambridge Aerophysics Lab.
RECENT ADVANCES IN THE DEVELOPMENT OF A MAGNETIC SUSPENSION AND BALANCE SYSTEM FOR WIND TUNNELS (PART II) [Technical Report, Aug. 1962-Aug. 1963]
Eugene E. Covert, Alan B. Copeland, Timothy Stephens, and Edward Lee Tilton, III Wright-Patterson AFB, Ohio, Aerospace Res. Labs., Mar. 1964 45 p refs
(Contract AF 33(616)-7023)
(ARL-64-36; AD-437696)

This report presents a discussion of the recent development work on a magnetic model suspension and balance system. System equipment additions and modifications are described. A summary of calibration procedures and wind-tunnel tests is given. Studies on methods of roll control, magnetic field distribution, and a new digital model position indicator are discussed. Author

N64-20600* Autonetics, Downey, Calif.
[AIRBORNE APPROACH AND LANDING SYSTEM STUDY] Monthly Progress Report No. 3, Period Ending Mar. 28, 1963
J. W. Montooth 4 Apr. 1963 4 p
(NASA Contract NAS2-1201)
(NASA CR-53969) OTS: $1.10 ph

The current program status is as follows: (1) Various combinations of sensors are being investigated. (2) A preliminary evaluation of the display equations shows that the use of suitable small angle approximations to simplify the complexity of the equations results in adequate equations for display purposes. (3) A minor addition to the display format appears to make the display more useful. If the runway lines are inclined

to the horizon line by an amount equal to the ship's heading error for the runway, the display has a slightly more realistic appearance and the heading errors are noted earlier. (4) The use of the R14A Direct Radar Flight Indicator for the presentation of the approach and landing display appears feasible although some modifications would be required. (5) An investigation of the Marine-Verdan Computer output characteristics to determine the compatibility of the computer outputs with the R14A indicator revealed no major interface problems. The indicator can be parallel with another remote control CRT. I.v.L.

N64-20706* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AIRCRAFT VORTEX WAKES IN RELATION TO TERMINAL OPERATIONS
Joseph W. Wetmore and John P. Reeder [1962] 33 p refs Presented at the Symp. on the Develop. of Analytical Models for Estimating Airport Capacity, Richmond, Calif., 29–30 Nov. 1962
(NASA TM X-51683) OTS: $3.60 ph

The purpose of this paper is to examine the problems associated with trailing vortices, particularly in the airport terminal area where separation of aircraft must be kept to a safe minimum for efficient traffic handling and where the low flight speeds result in more intense vortices. A brief discussion is given of the formation of trailing vortices from lifting surfaces and of the effects of such major factors as aircraft weight, wingspan, and speed on intensity and extent of the resulting airflow disturbance. The decay of vortex intensity with time is considered in the light of available experimental results and theory. Effects on aircraft encountering trailing vortices, including structural loads, upset, and settling, are considered together with the influencing factors. Finally, the theoretically determined timewise settling and spreading of the trailing vortices from an airplane in typical takeoff and landing are described and discussed in relation to safe procedures for following airplanes. Airplanes considered as examples in the discussion include a heavy jet transport of 300,000-lb gross weight, a 35,000-lb light turboprop transport, and a 2,000-lb light personal airplane. Author

N64-20714 General Electric Co., Syracuse, N. Y. Electronics Lab.
CAPABILITIES, FACILITIES AND EXPERIENCE
Dec. 1963 18 p refs

Capabilities, facilities, and experience of the radiation effects operation are described. Capabilities include: (1) analysis of systems and equipment behavior in one or more of the several radiation environments and investigation of radiation sources, propagation, and effects on basic materials and equipment; (2) basic studies and experimental investigations of effects of radiation on materials; (3) development and design of special equipment for use in radiation detection and measurement and development of design criteria and guides for radiation-hardened equipment; and (4) qualification test programs to determine component and systems compliance with specifications. The nuclear radiation facilities enhance competence in the design of equipment for operation in the damaging environment of high nuclear radiation, aid in exploring the beneficial effects of nuclear radiation, and provide the means for carrying out research programs in nuclear and particle physics. Experience includes environmental studies, design and construction, testing, and design guide preparation in the general areas of nuclear weapons effects, space radiation effects, nuclear radiation effects, and special instrumentation. I.v.L.

11 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; 13 Heat Transfer and Thermodynamics; and 24 Physics, Plasma.

N64-20028 Air Force Systems Command, Griffiss AFB, N.Y. Research and Technology Div.
DIELECTRIC GASES: REDUCTION OF LEAKAGE COSTS IN HIGH POWER MICROWAVE SYSTEMS
Vincent C. Vannicola and Leon L. Stevens Mar. 1964 15 p (RADC-TDR-64-67; AD-438052)

Studies and experimental investigations have established the technical basis for reducing the enormous costs caused by the leakage of sulfur hexafluoride from high-power microwave systems. Sulfur hexafluoride was diluted with nitrogen or air without undergoing proportionate degradations in peak power handling capability. At slightly higher gage pressures, such diluted mixtures were used without reducing peak power handling capability. Procedures for mixing sulfur hexafluoride and other dielectric gases with nitrogen, air, and oxygen are given for maximum efficiency and safety. Practical application of the results can reduce leakage costs by 50% to 70%. Various examples are given. The adaptation of this technique to high-power microwave systems is recommended where leakage of sulfur hexafluoride is a significant cost consideration. Author

N64-20083 California U., Berkeley Inst. of Engineering Research
THE INCOMPRESSIBLE LAMINAR AXISYMMETRIC WAKE BEHIND A VERY SLENDER CYLINDER IN AXIAL FLOW
Henri Viviand and Stanley A. Berger 3 Feb. 1964 47 p refs (Contract Nonr-222(45))
(AS-64-5; AD-436584)

An attempt is made to solve the near-wake problem behind a very slender cylinder in axisymmetric incompressible laminar flow by a series expansion method. Although the solution thus found applies only up to a very limited distance downstream of the base, it exhibits important differences with the corresponding two-dimensional problem of the wake behind a flat plate, which are characteristic of the axisymmetry of the flow. This series expansion and an asymptotic expansion for the far-wake region are compared with a simple solution obtained by linearizing the momentum equation. Author

N64-20286* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CHARTS FOR THE ANALYSIS OF ISENTROPIC ONE-DIMENSIONAL UNSTEADY EXPANSIONS IN EQUILIBRIUM REAL AIR WITH PARTICULAR REFERENCE TO SHOCK-INITIATED FLOWS
William L. Grose and Robert L. Trimpi Washington, NASA, Dec. 1963 20 p refs
(NASA TR R-167) OTS: $0.50

Charts are presented to simplify the theoretical analysis of certain flow processes involving an unsteady expansion wave in equilibrium real air. The parameters evaluated are related to (1) the velocity change in an unsteady expansion wave, (2) the maximum velocity attainable in a shock-wave–expansion-wave

cycle, (3) the time for characteristic traversal through an expansion wave, and (4) the entropy in shock-initiated flows. Such parameters are of particular interest in analysis of the shock-initiated expansion-tube cycle. Author

N64-20304 Nebraska U., Lincoln Hydrodynamics Lab.
MECHANISM OF TURBULENCE GENERATION IN PULSATING VISCOUS FLOW Technical Report, Mar. 1962-1964
Turgut Sarpkaya [1964] 121 p refs
(Grant DA-ARO(D)-31-124-0261; DASA WEB-07.010)
(NU-Hydro-012-TS; AROD-3202.1; AD-438511)

An analytical and experimental study was carried out to determine the transition from laminar to turbulent flow of an axially symmetrical laminar flow pulsating under a sinusoidal pressure gradient. For the purpose of this investigation, a smooth circular conduit, a surge tank, two pumps, and a scotch-yoke were employed. The working fluid was a light oil specially selected to obtain the desired range for the basic parameters controlling the phenomenon. It was found that, for the same mean pressure gradient, pulsating flow is more stable than the corresponding steady Poiseuille flow. The critical value of the Reynolds number increases at first and then decreases rapidly as the mixing-volume parameter M increases. M is defined in terms of the characteristics of double inflection circles occurring in the fluctuating velocity profile. It was also found that the critical values of the Reynolds number decrease with increasing values of the frequency parameter. It is concluded that the mechanism of transition to turbulence in pulsating flow is a gradual process as in the case of steady flow. R.T.K.

N64-20322 Aerospace Corp., El Segundo, Calif. Aerodynamics and Propulsion Research Lab.
WALL ROUGHNESS EFFECTS ON INVISCID NONEQUILIBRIUM FLOW IN DUCTS
C. Ortloff 16 Mar. 1964 76 p refs
(Contract AF 04(695)-269)
(TDR-269(4230-20)-6; SSD-TDR-64-28; AD-438477)

The mean-square pressure fluctuation at the walls of a duct containing inviscid nonequilibrium flow is derived for cases of exponential and delta function autocovariance wall roughnesses for subsonic and supersonic Mach numbers. Solutions for two- and three-dimensional sinusoidal walls are also included. For the limiting cases of frozen and equilibrium flows (for supersonic and subsonic Mach numbers), the random roughness wall solutions for the first-order potential are given in terms of source and sinklike singularities, the strengths of which are proportional to the local wall slope, and may be taken as randomly distributed along the wall. The mean-square fluctuation quantities are shown to be related to the autocovariance function of the first derivative of the wall roughness function. The dependence on the mean-square pressure fluctuation of certain statistical properties of the roughened wall is shown to be factorable from the pressure fluctuation expression. Author

N64-20365 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
HYDRODYNAMIC EQUATIONS WITH ACCOUNT OF RADIATION
S. Z. Belen'kiy *In its* Trans. of the Physics Inst. 21 Mar. 1963 p 20-30 refs (See N64-20363 13-01)

The paper contains two different methods of deriving fundamental equations of hydrodynamics when the factor of radiation is taken into account: (1) starting from accepted laws of conservation of matter, momentum, and energy; and (2) starting from the energy-momentum tensor for a system consisting of an aggregate of particles and radiation. A.W.

N64-20368 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THERMOACOUSTICAL INSTABILITY OF A HETEROGENEOUS GAS FLOW
K. I. Artamenov and I. G. Krutikova *In its* News of the Academy of Sci. of the USSR 22 Apr. 1963 p 1-11 refs (See N64-20367 13-01)

An investigation of the stability of a one-dimensional single-velocity flow with distributed internal heat sources is reduced to finding the characteristic values of the boundary-layer problem for a system of 3 ordinary differential equations. The characteristic values were numerically determined on a digital computer for 2 laws of heat conduction: (1) The heat-supply rate is proportional to the density of the gas. (2) The heat-supply rate is proportional to the mass of the gas in a given cross section of the flow. Presented is a discussion of equations of heterogeneous flow, methods of solution, and characteristic values and stability boundaries. P.V.E.

N64-20422 France. Ministere de l'Air, Paris
SHOCK TUBES: CONCEPTION AND RESEARCHES [LES TUBES A CHOC: CONCEPTION ET RECHERCHES] Scientific and Technical Publication, Technical Note No. 130
Charles Chartier, Yves Marie Grellier (Faculte des Sci. de Poitiers), and Raymond Brun (C.N.R.S.) Paris, Service de Documentation Sci. et Tech. de l'Armement, 1963 39 p refs in FRENCH

This report discusses: (1) the development of two large-section shock tubes; (2) the technology of assemblage and functioning; and (3) the methods for measuring speed and pressure, and visual techniques. Research in progress and planning deals with the study of the downstream flow of an incident shock in air, the rate of ionization downstream of a shock wave in rare gases, and the relaxation in triatomic linear molecular gases. These shock tubes permit measurements and visualization for a range of relative moderate Mach numbers. I.v.L.

N64-20552 Aeronautical Research Labs., Melbourne (Australia)
FURTHER BOUNDARY LAYER TESTS IN THE VORTEX WIND TUNNEL
P. A. Salter (Tasmania U.) Mar. 1963 51 p refs
(ARL/ME-255)

The pressure distributions on the rotor and stator blades of the vortex wind tunnel were measured. Points of laminar separation were calculated from these measurements and compared with experimental values obtained by the china clay and oil film techniques; moderate agreement was found. Further comparisons were made with two-dimensional tests carried out in a low-speed cascade tunnel, and some interesting differences were noticed. The existence of a region of laminar flow followed by laminar separation, transition to turbulence, and turbulent reattachment on the suction surface was confirmed by the visualization studies. Some visualization studies of cross-flow within the boundary layer are reported. Author

N64-20652 Space Technology Labs., Inc., Los Angeles, Calif.
STUDY OF RAREFIED SHEAR FLOWS BY THE DISCRETE VELOCITY METHOD
James E. Broadwell Mar. 1963 23 p refs
(Rept. 9813-6001-RU000)

Low-density Couette and Rayleigh flows are studied by means of a simplified kinetic theory. The simplification involves: (1) restricting the allowed molecular velocities to a finite set, consisting in this study of eight, equal speed velocities; and (2) applying the Krook approximation to the Maxwell–Boltzmann equation. In spite of its great simplicity, the resulting model reproduces many of the essential features of the solutions obtained from treatment of the full Maxwell–Boltzmann equation by moment methods. Of most interest is the fact that the present approach leads, in the Rayleigh problem, to the same governing equation as does the Maxwell moment method applied by Lees, namely, the telegraph equation. Author

N64-20697 Honeywell, St. Paul, Minn. Research Labs.
NORMAL AND OBLIQUE SHOCK WAVE PARAMETERS WITH DISSOCIATED AMBIENT CONDITIONS IN HYPERSONIC FLOW WITH VARIOUS CHEMICAL STATES ACROSS THE SHOCK
Janardanarao Yalamanchili Mar. 1964 53 p refs
(U-RD-6333)

This report presents tables and graphs of normal shock wave parameters for dissociated ambient conditions. Only the extreme cases of free-stream dissociation and free-stream static temperature are considered to show real gas effects due to the free-stream dissociation on shock-wave parameters. Two chemical states of high-temperature air are considered in this study, chemically and vibrationally frozen conditions across the shock, chemically frozen and vibrationally in equilibrium conditions across the shock. The real gas effects on the flow deflection angle behind an oblique shock wave due to dissociated free-stream conditions are also considered. The results cover the range of free-stream velocities from 3,000 fps to 50,000 fps, the free-stream dissociation up to the completion of nitrogen dissociation in air and free-stream static temperatures from 100° to 1,000° K. Author

N64-20721* Southwest Research Inst., San Antonio, Tex.
LIQUID SURFACE OSCILLATIONS IN LONGITUDINALLY EXCITED RIGID CYLINDRICAL CONTAINERS Technical Report No. 2
Franklin T. Dodge, Daniel D. Kana, and H. Norman Abramson 30 Apr. 1964 89 p refs
(NASA Contract NAS8-11045; SRI Proj. 13-02-1391)
(NASA CR-56135) OTS: $8.10 ph

Results of a theoretical and experimental study of low frequency liquid motions in a longitudinally vibrated tank are presented and discussed in some detail. Large amplitude free surface motions occur when the liquid responds as a one-half subharmonic of the excitation. This form of response exhibits the "jump" phenomena common to nonlinear systems. Harmonic and superharmonic liquid surface motions are also observed, although their amplitudes are considerably smaller than those corresponding to the one-half subharmonic response. Comparisons between theoretical and experimental results are given, in most instances the correlation being rather close. Author

12 GEOPHYSICS

Includes auroral phenomena; upper atmosphere studies; oceanography; cartography; geodesy; and geomagnetism. *For Van Allen belts see*: 28 Space Radiation. *For related information see*: 05 Astronomy and Astrophysics; 21 Meteorology; and 29 Space Sciences.

N64-20004* RAND Corp., Santa Monica, Calif.
THE SATELLITE DETERMINATION OF HIGH-ALTITUDE WATER VAPOR
E. E. May and A. B. Kahle Feb. 1964 14 p refs
(NASA Contract NASr-21(07))
(NASA CR-53937; RM-3986-NASA) OTS: $1.60 ph

Studying high-altitude water vapor by satellite observation of the 1.35-cm water-vapor line profile appears unfeasible. The water-vapor density distributions expected suggest that observations of this line will seldom, if ever, show large, easily discernible peaks. Since emission from the earth greatly reduces the line profile as seen by a satellite, ground observations are preferable. Author

N64-20008* Stanford U., Calif. Stanford Electronics Labs.
THE DISTRIBUTION OF IONS AND ELECTRONS IN THE EARTH'S EXOSPHERE Technical Report No. 4
J. J. Angerami and J. O. Thomas (NASA, Ames Res. Center) Dec. 1963 105 p refs
(NASA Grant NsG-30-60; AF AFOSR Grant 62-370)
(NASA CR-53689; SEL-63-110; Tech. Rept. 3412-3) OTS: $9.10 ph

The factors governing the distribution of electrons and ions in the earth's exosphere are discussed. The theory takes into account the effect of the electric field that arises from charge separation, the centrifugal force arising from the rotation of the earth, and the effect of the earth's gravitational field. It is assumed that the charged particles are constrained to move only along the direction of the earth's magnetic lines of force. The modifications that result in the electron and ion distributions when a temperature variation is assumed along a line of force are also considered. The results predicted by the theory are compared with actual experimental observations of the exospheric plasma that have been obtained in recent years using whistlers and topside ionograms made by the Alouette satellite. Author

N64-20016* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EXPERIMENTAL CONFIRMATION FROM THE TIROS VII METEOROLOGICAL SATELLITE OF THE THEORETICALLY CALCULATED RADIANCE OF THE EARTH WITHIN THE 15-MICRON BAND OF CARBON DIOXIDE
W. R. Bandeen, B. J. Conrath, and R. A. Hanel Repr. from J. Atmospheric Sci., v. 20, no. 6, Nov. 1963 p 609–614 refs
(NASA RP-163)

Results are presented of the preliminary data reduction of measurements of a medium-resolution radiometer on the Tiros VII satellite. These data are found to confirm theoretical radiance values of the earth and their independence of cloudiness, the predicted seasonal effects, and a small amount of limb brightening. The minimum and maximum blackbody temperatures observed agree well with theoretical predictions. IAA

N64-20018* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ANALYSIS OF TOPSIDE SOUNDER RECORDS
R. J. Fitzenreiter and L. J. Blumle Repr. from J. Geophys. Res. v. 69, no. 3, Feb. 1964 p 407–415 refs
(NASA RP-169)

A discussion is presented of methods for interpreting the data obtained by the Alouette, including an outline of a technique for reducing the topside sounder satellite data to electron density distributions with height. The most useful feature for

the calculation of electron density profile is the extraordinary trace; for accurate results, the effect of the geomagnetic field must be considered in the data reduction process. The method of analysis selected assumes that small sections of the profile can be approximated by exponential laminations, requiring fewer points than other first-order lamination techniques to achieve a given accuracy. That received echoes correspond to vertical propagation is an assumption, is not always valid, and can lead to large errors. The sounder also excites the medium in the immediate vicinity of the satellite, giving rise to various plasma resonances. A graph is given summarizing the local effects seen on the ionograms, and can be used for rapid identification of these resonances. IAA

N64-20094 Air Force Cambridge Research Labs., Bedford, Mass. Meteorology Lab.
OZONESONDE OBSERVATIONS OVER NORTH AMERICA, VOLUME I
Wayne S. Hering, ed. Jan. 1964 525 p ref
(AFCRL-64-30(1); AD-435873)

A systematic observational program designed to extend knowledge of the structure and behavior of the vertical ozone distribution was initiated. A network of 11 ozonesonde stations was established with the cooperation of the Air Weather Service, the Canadian Meteorological Branch, and five universities in the United States. The 1963 schedule of balloon-borne ozonesonde observations consisted of ascents each Wednesday at all network stations. The ozonesonde observation, which included companion measurements of temperature, pressure, and humidity, was substituted for the conventional radiosonde ascent at those network stations that are a part of the radiosonde network. In addition to the regular Wednesday observations, a special synoptic series of daily launches at 1200Z at all stations was scheduled for the period 29 April to 10 May 1963. The published data also include a few unscheduled ascents made in situations of special meteorological interest. A list of ascents contained in this volume is given. Author

N64-20095 Space-General Corp., El Monte, Calif.
EXPERIMENTAL RESEARCH INVESTIGATION OF EXTREMELY LOW FREQUENCY PROPAGATION Final Report
G. R. Dunn, P. F. Kuhnle, and R. D. Smith 28 Feb. 1964 74 p refs
(Contract AF 19(628)-1603)
(AFCRL-64-164; SGC-212R-8; AD-437777)

Characteristics of ELF electromagnetic-wave propagation were investigated by measuring the characteristics of cw signals transmitted over a 400-cps link established between Bishop, California, and Sault Ste. Marie, Michigan, a distance of 3,000 km. A 67-mile section of power transmission line extending from Bishop, California, to Silver Peak, Nevada, was used to radiate the 400-cps energy. Data that could be reduced to yield signal strength, attenuation rate, transmission path phase variations, and atmospheric noise amplitude probability distributions (APD) were recorded. The measured attenuation rate was 3.5 db/1,000 km for a nighttime path and 9 db/1,000 km for a daytime path. Reduction and analysis of the transmission path phase data showed sunrise diurnal phase variations ranging from 150° to 200°. Measurements are compared with path characteristics calculated using existing theoretical treatments of ELF propagation. Atmospheric noise data were recorded for all transmission periods. Data are presented in the form of amplitude probability distributions and impulses per unit time distributions. Performance measurements and calculations for the powerline transmitting antenna are presented. Author

N64-20175 Ohio State U. Research Foundation, Columbus Inst. of Geodesy, Photogrammetry and Cartography
THE EFFECT OF TOPOGRAPHY AND ITS ISOSTATIC COMPENSATION ON FREE AIR GRAVITY ANOMALIES Scientific Report No. 2
Lassi Kivioja Dec. 1963 148 p refs
(Contract AF 19(628)-2771)
(Rept. 28; AFCRL-64-130; AD-438966)

The effect of topography and its isostatic compensation for all 5° × 5° surface elements has been calculated, using the T = 30 km, Airy–Heiskanen local isostatic system, and the available 5° × 5° mean free air anomalies based on measurements. Measured 5° × 5° mean free air anomalies on the Atlantic Ocean, on the North American Continent, and at its shores were the test areas used for the adjustments. In the test areas, these calculated 5° × 5° mean free air anomalies would represent the measured 5° × 5° mean free air anomalies so that the standard errors on the oceans are about ±6 mgal on continents, and at the coasts are about ±11 mgal. The calculated anomalies are developed into spherical harmonics up to the 8th order. Also, 5° × 5° mean free air anomalies for the entire earth are given. Author

N64-20228 Joint Publications Research Service, Washington, D.C.
TECHNICAL INSTRUCTIONS FOR MAGNETIC PROSPECTING
V. Ye. Nikitskiy 7 May 1964 325 p refs Transl. into ENGLISH from the book "Tekhnicheskaya Instruktsiya po Magnitnoy Razvedke", Moscow, Gosgeoltekhizdat., 1963 p 3–247
(JPRS-24511; OTS-64-31224) OTS: $5.00

Among the techniques discussed are the following: (1) methods and techniques of carrying out aerial magnetic prospecting operations; (2) procedures and techniques involved in ground magnetic prospecting operations; (3) the accounting for diurnal variations of the geomagnetic field in aerial and ground magnetic surveys; (4) the measurement of the magnetic characteristics of rocks, and ores for magnetic prospecting operations; (5) magnetic measurements in wells and mines; (6) magnetic measurements in the studies of dispersion halos; (7) inspection, technical verification, and acceptance of field work; (8) final processing and preparations for the interpretation of materials yielded by magnetic prospecting operations; (9) instructions pertaining to large scale, complex aerial magnetic surveying; (10) instructions on the compilation and publication of maps of magnetic field anomalies to the scale of 1:1,000,000 and 1:1,200,000; (11) ground support of aerial magnetic surveys; (12) micromagnetic surveying procedure; (13) special procedural techniques in aerial magnetic surveying in mountainous terrain; (14) the processing of variation magnetograms; and (15) main requirements in the measurement of magnetic characteristics of rock in paleomagnetic investigations. R.T.K.

N64-20231 Joint Publications Research Service, Washington, D.C.
THE REORGANIZATION OF HYDROMETEOROLOGY
Ye. K. Fedorov 8 May 1964 11 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), no. 1, 1964 p 16–21
(JPRS-24528; OTS-64-31233) OTS: $0.50

The principal objectives of the Hydrometeorological Service of the Soviet Union are the making of systematic observations of the state of the atmosphere, as well as observations of rivers, seas and agricultural crops, analysis of the results of observations, study of the regime of meteorological phenomena and the development of methods for modifying them, and the forecasting of the future state of the atmosphere. The basic

plan for the collection of hydrometeorological information and the technical reorganization of the service are discussed. R.T.K.

N64-20234 Joint Publications Research Service, Washington, D.C.
SOME NEW DATA ON THE THERMAL REGIME OF THE WATERS OF THE NORTHEASTERN PART OF THE PACIFIC OCEAN
A. F. Plakhotnik 14 May 1964 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), vol. 155, no. 1, 1964 p 187–190
(JPRS-24609; OTS-64-31263) OTS: $0.50

Investigations of fishery areas in the western part of the Gulf of Alaska were performed in 1960–1962 by fishery-research expeditions of the All-Union and Pacific Research Institutes of Marine Fishery and Oceanography. These investigations included hydrological studies of the area. The major area of interest was the area's thermal regime. The results of these studies are presented. R.T.K.

N64-20296 Pennsylvania State U., University Park Ionosphere Research Lab.
INVESTIGATION OF PHASE INTERACTION AS A MEANS FOR THE STUDY OF THE LOWER IONOSPHERE Scientific Report No. 206
S. Weisbrod 1 Mar. 1964 161 p refs
(Contract AF 19(628)-3842)
(AFCRL-64-32; AD-435736)

The research described is concerned with a new technique for the study of the lower ionosphere. This technique is based on the simultaneous observations of phase and amplitude wave interaction. The magnitude of the observed phase perturbation is on the order of 10^{-4} radians (approximately 20 seconds of arc). The scheme is based on the extension of the Fejer pulse technique. The theory of interaction is extended and generalized by the introduction of the complex coefficient of interaction, which embodies both amplitude and phase effects. The experimental results are in very good qualitative agreement with the theoretical computations based on simple but realistic ionospheric models. On the average, below 75 or 80 km, the phase perturbations, measured in radians, are stronger than the amplitude perturbations. The maximum values of phase and amplitude perturbations are comparable. Author

N64-20317 Lockheed Missiles and Space Co., Sunnyvale, Calif.
SUB ELF GEOMAGNETIC FLUCTUATIONS. VOLUME I: FREQUENCY-TIME CHARACTERISTICS OF HYDROMAGNETIC EMISSIONS Final Report, 8-08-64-1
Lee Tepley, R. C. Wentworth, and K. D. Amundsen 26 Dec. 1963 111 p refs
(Contract AF 19(628)-462)
(AD-437332)

Results are presented of recent measurements of hydromagnetic emissions at four Pacific Ocean stations widely separated in both latitude and longitude. The signals were observed simultaneously at the four locations. The repetition frequency of the emission fine structure was highly regular and was the same at all stations for any given hm emission event. The structural elements were observed simultaneously at stations in the same hemisphere, but the elements were alternately spaced (180° out of phase) in emissions observed simultaneously at stations on opposite sides of the Equator. Hence, energy was received periodically and alternately in the Northern and Southern Hemispheres. The result was applied to the evaluation of three recently proposed models for the generation of hm emissions; two of the three models were rejected. Occasionally, the fine-structure repetition-frequency exhibits the presence of a harmonic. The effect, referred to as "structure-doubling" is tentatively interpreted as resulting from a super-position of signals from opposite hemispheres. Author

N64-20346 Raytheon Co., Norwood, Mass.
MEASUREMENT OF PHASE CONSTANT FOR ROCK PROPAGATED SIGNALS Scientific Report No. 2
Carson K. H. Tsao Dec. 1963 20 p refs
(Contract AF 19(628)-2362)
(AFCRL-64-64; AD-435742)

A method is described for determining the phase constant of the rock medium below the surface of the earth. The constant is deduced from the measured phase angle of the mutual impedance between two vertically polarized antennas placed in drill holes extending into the rock. Experiments were conducted on Cape Cod, Massachusetts, using the method to determine the phase constant of the rock between two 1,000-ft drill holes, separated by a distance of 6,000 ft, at frequencies between 100 and 4,200 cps. Electrically short monopoles were used in the drill holes, with the overburden above the rock serving as a ground plane. Reference phase was derived from Loran C transmissions at both the transmitting and receiving ends of the path. The measured phase constants at these frequencies indicate a large loss tangent for the medium. The bulk conductivity was thus deduced to be 1.1×10^{-3} mhos/meter, and the measurements did not yield an estimate of the relative dielectric constant. Author

N64-20354 Texas U., Austin Electrical Engineering Research Lab.
ATMOSPHERIC PARAMETERS FOR FOUR QUIESCENT EARTH CONDITIONS
W. E. Sims and F. X. Bostick 1 Sep. 1963 34 p refs
(Contract Nonr-375(14))
(Rept. 132; AD-422548)

Certain parameters as functions of altitude and magnetic latitude were tabulated for the following four different quiescent earth conditions: daytime maximum sunspot activity; daytime minimum sunspot activity; nighttime maximum sunspot activity; and nighttime minimum sunspot activity. The parameters tabulated are: geomagnetic-field intensity (calculated by centered dipole approximation); gyrofrequencies of electrons and ions (calculated from standard cyclotron equations); the plasma or critical frequency; and the collision frequencies between electrons, ions, and neutral particles (calculations that were made from somewhat empirical equations due to the difficulty in obtaining accurate expressions for the collision distance). All units are given in the rationalized MKS system except for the altitude, which is given in kilometers. A.W.

N64-20469 Library of Congress, Washington, D.C. Aerospace Information Div.
PHENOMENA IN THE UPPER ATMOSPHERE. COMPILATION OF ABSTRACTS FROM SOVIET LITERATURE
24 Apr. 1964 20 p refs
(AID-P-64-30; AD-439227) OTS: $1.60 ph

The following topics are covered: (1) ionospheric electron concentration; (2) solar radiation and the ionosphere; (3) Van Allen Belts and cosmic rays; (4) telluric currents; and (5) meteorology of the upper atmosphere. R.T.K.

N64-20470 Library of Congress, Washington, D.C. Aerospace Information Div.
PHENOMENA IN THE UPPER ATMOSPHERE. COMPILATION OF ABSTRACTS FROM SOVIET LITERATURE

29 Apr. 1964 22 p refs
(AID-P-64-31; AD-439228) OTS: $2.60 ph

The following topics are covered: (1) solar radiation and the ionosphere; (2) Van Allen belt and cosmic rays; (3) atmospheric electricity; (4) nuclear bursts in the atmosphere; and (5) meteorology of the upper atmosphere. R.T.K.

N64-20501* Minnesota U., Minneapolis
NEUTRAL COMPOSITION OF THE ATMOSPHERE IN THE 100- TO 200-KILOMETER RANGE
Alfred O. Nier, J. H. Hoffman, C. Y. Johnson, and J. C. Holmes (NRL). Repr. from J. Geophys. Res., v. 69, no. 5, 1 Mar. 1964 p 979–989 refs
(NASA Grant NsG-286-63)

The neutral composition of the atmosphere in the altitude range 100 to 200 km has been studied with a simple magnetic mass spectrometer flown on an Aerobee rocket. The variations of N_2, O_2, and O concentration with altitude were found from the mass spectrums obtained and the laboratory calibration of the instrument. The $O–O_2$ ratio increased with altitude, reaching a value above 15 at the peak of the flight, 209 km. The $O_2–N_2$ ratio decreased with altitude. Mean molecular weights and mass densities were computed as functions of altitude from the particle number density data. Author

N64-20503 Boeing Scientific Research Labs., Seattle, Wash.
PROGRESS REVIEW: GEO-ASTROPHYSICS LABORATORY, LAST SIX MONTHS 1963
J. C. Noyes et al Feb. 1964 44 p refs

This review of program status includes the following: (1) Scans have been made of the illuminated moon for 19 of its phases in the visible and infrared (10 to 12 micron) wavelengths. (2) Some equipment changes have been made on the neutron spectral equipment installed on an Air Force KC-135 airplane. An analysis of neutron-flux data obtained in a flight at high latitudes (85° N geographic) has been initiated. (3) A field station to record micropulsations of the earth's magnetic and telluric fields is in operation. (4) The effect on the ionosphere of the decay protons from the neutrons emitted from a nuclear explosion has been investigated. The ionization region produced by the protons cannot be considered an important mechanism for explaining the prompt effects on VLF radio transmission at distances remote from the blast and conjugate areas. (5) It is indicated that there is an annual background noise that, by varying the threshold for echo detection could account for the annual variation in the number of echoes received by whistler mode. (6) The scattering of microwaves from a random water surface has been resolved into phase components, both coherent and incoherent. (7) An integral expression has been obtained for gravity surface waves in hydromagnetic fluids, and a closed-form expression has been obtained for magnetohydrodynamic flows in the presence of current loops. I.v.L.

N64-20529 Atomics International, Canoga Park, Calif.
A DISCUSSION AND BIBLIOGRAPHY OF CURRENT LITERATURE CONCERNING VAN ALLEN BELTS FOR USE IN SNAP SPACE ENVIRONMENTAL STUDIES
V. E. Kistler 15 Feb. 1963 49 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-7849) OTS: $1.00

This report presents a bibliography of theoretical and experimental papers concerning the Van Allen trapped radiation belts. Also, a general discussion of past history and conclusions from some experimental and theoretical work are presented. This information is applicable to the evaluation of space radiation influences upon SNAP reactor systems. All results quoted are subject to change, since additional information and improved instrumentation may provide new bases for the interpretation of experimental data. Author

N64-20534 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
THE DENSITY OF THE UPPER ATMOSPHERE AT HEIGHTS OF 200-230 KM [PLOTNOST' VERKHNEI ATMOSFERY NA VYSOTAKH 200-230 KM]
M. Ya. Marov London, Min. of Aviation, Mar. 1964 7 p refs Transl. into ENGLISH from Kosmich. Issled. (USSR), v. 1, no. 1, 1963 p 143–146
(RAE-TRANS-1060)

Information is given on the retardation of the satellites Cosmos 3 and Cosmos 5, and estimates are made of the density of the atmosphere in the region of their perigee. Author

N64-20557 National Physical Lab., New Delhi (India) Radio Propagation Unit
IONOSPHERIC DATA, JANUARY 1963
[1963] 60 p
(RRC-A92)

The ionospheric data presented are those of Delhi, Bombay, Madras, Tiruchirapalli, and Trivandrum, Haringhata, Ahemedabad, and Kodaikanal. The data include: (1) the ordinary-wave critical frequency for the E-, F1-, and F2-layers; (2) the ordinary-wave top frequency corresponding to the highest frequency at which a mainly continuous trace is observed in the Es region (foEs data); (3) minimum virtual height on the ordinary-wave branch for the E-layer; (4) minimum virtual height on the ordinary-wave branch for the lowest F-region stratification; (5) minimum virtual height on the ordinary-wave branch for the highest F-region stratification; and (6) the lowest virtual height of the trace used to give the foEs data. The geographic, geomagnetic, and magnetic locations of the stations and the equipment used are given. Also, solar and magnetic data are presented. I.v.L.

N64-20558 National Physical Lab., New Delhi (India) Radio Propagation Unit
IONOSPHERIC DATA, FEBRUARY 1963
[1963] 60 p For abstract see N64-20557 13-12
(RRC-A93)

N64-20611 Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.
NEAR EARTH IONIZING RADIATION AND ELECTRONIC CIRCUITRY
A. F. Hogrefe Jul. 1963 47 p refs
(Contract NOw-62-0604-c)
(TG-510; AD-430709)

A survey of data on surface- and bulk-damage effects on transistors and diodes in an ionizing radiation environment was made. Circuits designed in such a manner that they are sensitive to surface effect, and incorporating nonplanar transistors, tend to exhibit large increases in leakage current at flux dosages of about 10^5 rads. Circuits drawing significant continuous collector current are inherently immune from the surface effect. Planar transistors are generally considered to be immune from surface effect, but exceptions to this have been noted. Bulk damage becomes significant at higher integrated dosages than surface effect, and for near-earth payloads, it could be ignored prior to the nuclear events of 1962. It now appears necessary to modify circuit design somewhat to provide for the desired 5-year life. The techniques to accomplish this consist of selecting transistors of 100 mc and

higher alpha cutoff and of the designing of circuitry for as large a deterioration in beta as is possible. R.T.K.

N64-20614 Weapons Research Establishment (Australia)
IONOSPHERIC DATA FOR JULY, 1963 FROM SALISBURY, SOUTH AUSTRALIA
Jan. 1964 26 p
(CPD-1963/7(S))

Tabulations of ionospheric data obtained hourly at Salisbury, South Australia, located at 34.7° S and 138.6° E, are presented. Data on the E and F layers of the atmosphere are included. R.T.K.

N64-20619 Illinois U., Urbana Engineering Experiment Station
STUDIES IN SPATIAL AEROTRIANGULATION: Technical Report No. 5
H. M. Karara 1963 57 p refs
(*Its* Bull., v. 61, no. 1, Aug. 1963) Available from *Its* Eng. Publ. Office: $1.00

This report deals with and explains the cross-bases method in aerotriangulation. In regions having no geodetic control, the unknown deviation of the vertical could have considerable effect on the ground control necessary for photogrammetric work. Even though astronomical fixes could be made available, the unknown magnitude of the station error may introduce considerable weakness in astronomic control. On the other hand, the deflection of the vertical will have relatively little effect upon the astronomical azimuths of base lines. Thus, a method that makes use of measured base lines instead of position coordinates of ground control points would certainly have particular advantage in geodetically unexplored regions. Also discussed are the capabilities and limitations of spatial aerotriangulation in reducing the amount of ground control necessary for photogrammetric mapping. The importance of advance planning in projects involving bridging is pointed out. Definite design criteria are given for the aerotriangulation projects, sharply reducing the necessity of relying heavily on luck or extensive experience. Author

N64-20626 Weapons Research Establishment (Australia)
HIGH FREQUENCY RADIO WAVE REFLECTION BY SPORADIC E IONIZATION
C. G. Mc Cue and Z. R. Jeffrey Nov. 1963 23 p refs
(WRE-TN-CPD(T)101)

Some experimental results are presented pertaining to the reflection by sporadic E of high frequency radio waves incident at oblique angles. Variations in angle of arrival, conformity to the secant law, and reflection dependence on sporadic E type are discussed. Author

N64-20640* Smithsonian Astrophysical Observatory, Cambridge, Mass.
GEODESICS ON AN EQUIPOTENTIAL SURFACE OF REVOLUTION
Walter Kohnlein 10 Feb. 1964 39 p refs
(NASA Grant NsG-87-60)
(NASA CR-56078; SAO Special Rept.-144) OTS: $3.60 ph

An equipotential surface of revolution is propagated as a reference surface for a worldwide geodetic system. A trigonometry—using geodesics as surface curves—is briefly outlined, and the geodetic applications are given in the most important cases. The developments are valid for any length of the geodesics customarily used for "long lines" on an ellipsoid of revolution. The figure of the earth is usually identified with the geometrical structure of a certain equipotential surface of the gravity field, called the geoid. In geodesy this geoid is used as a reference surface for geodetic measurements, but in numerical computations, an easier manipulating surface such as a sphere or an ellipsoid of revolution is usually substituted for the geoid. Hence these latter reference surfaces must fulfill two major conditions: (1) they must represent the mean structure of the geoid in an area under consideration as well as possible; and (2) they must allow a simple computation procedure when geodesics are used as surface curves. Investigated is a reference surface that not only fulfills the above conditions but also shows some characteristics that make it especially suitable for worldwide geodetic systems. Author

N64-20649 Bureau of Mines, Pittsburgh, Pa. Coal Research Center
RARE ELEMENTS IN COAL
R. F. Abernethy and F. H. Gibson Washington, Bur. of Mines, 1963 74 p refs
(BMIC-8163)

The following topics are discussed: (1) the origin of rare elements in coal; (2) rare elements in analyses of ash; (3) the occurrence of 32 rare and minor elements in coal (not including silicon, aluminum, iron, calcium, magnesium, sodium, potassium, and sulfur, which constitute the main part of the mineral matter in most coals); and (4) the occurrence of germanium and gallium in coal. R.T.K.

N64-20673 Texas Western College, El Paso Schellenger Research Labs.
METEOROLOGICAL ROCKET DATA PROFILE OF THE STRATOSPHERE – McMURDO, ANTARCTICA
Ralph A. Rotolante and Alice Marie Parra Mar. 1964 56 p refs
(NSF G-19284)

A brief description of the stratospheric circulation and temperature structure at McMurdo, Antarctica, is presented. Special emphasis is given to the period of rapid stratospheric warming. Also included are the wind and temperature profiles obtained by the Antarctic Meteorological Rocket Program during its initial year. Author

N64-20674* Alaska U., College Geophysical Inst.
THE DYNAMICS OF THE AURORA – I. INSTABILITIES OF THE AURORA
S.-I. Akasofu and D. S. Kimball Repr. from J. Atmospheric and Terrest. Phys., v. 26, 1964 p 205–211 refs
(NASA Grant NsG-201-62)

Various forms of the aurora result from several active features added to a quiet, homogeneous arc. The development of the additional features, such as the small-scale folding, the large-scale wave, the β-band, and the large-scale coiling, is studied in detail. The space charge instability alone cannot produce the large-scale deformations, and both the space charge instability and hydromagnetic instability play a role in a complicated display. Author

N64-20736* Chicago U., Ill.
MINIMUM VERTICAL SCALE SIZES IN THE WIND STRUCTURE ABOVE 100 KILOMETERS
C. O. Hines [1964] 7 p refs Submitted for Publication
(NASA Grant NsG-467)
(NASA-CR-53793) OTS: $1.10 ph

Zimmerman (1964) presented a comparison between the small-scale wind structure that can be detected at high altitudes and the theoretical minimum structure sizes that can be attributed to freely propagating internal atmospheric gravity waves. He found that the theoretical curve adequately represented the minimum observed sizes at altitudes up to 130 km, but that, at

least for the summer data, it fell substantially short of the observed sizes at higher altitudes (up to 180 km). In this report an explicit formula for the theoretical curve is derived, and the revised curve that it yields is compared with the data points presented by Zimmerman. The basic formula, which states the conditions for a quenching of internal gravity waves, is: $2\pi\eta k_z^2 = \omega(1 - \omega^2/\omega_g^2)$ where η is the kinematic viscosity, k_z is the real vertical wave number, ω is the circular frequency, and $\omega_g^2 \equiv (\gamma - 1)g^2/C^2$ where γ is the specific heat ratio, g is the acceleration due to gravity, and C is the speed of sound. I.v.L.

N64-20737* Chicago U., Ill.
CORRECTION TO "INTERNAL ATMOSPHERIC GRAVITY WAVES AT IONOSPHERIC HEIGHTS"
C. O. Hines [1964] 7 p refs Submitted for Publication
(NASA Grant NsG-467)
(NASA-CR-53839) OTS: $1.10 ph

Zimmerman (1964) reports that, at high altitudes, there is a departure of the minimum scale sizes in ionospheric winds from the theoretical minimum reported by Hines (1960). Whereas the departure was in an acceptable direction, in the sense that the theoretical minimum scale sizes were less than the minimum observed scale sizes, a reexamination of the theoretical work was indicated. It became apparent that a computational or plotting error had been made in the preparation of the diagram depicting conditions at 225 km (Hines) and therefore in the theoretical curve used by Zimmerman. The present paper is concerned with the revisions that are necessary in the Hines paper. R.T.K.

13 HEAT TRANSFER AND THERMODYNAMICS

Includes ablation; cooling; heating; and other thermal effects. *For aerothermodynamics see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 03 Aerodynamics of Wings, Rotors, and Control Surfaces. *For combustion see*: 26 Propellants and Combustion. *For related information see*: 11 Fluid Mechanics.

N64-20117 RAND Corp., Santa Monica, Calif.
NOTE ON CONDUCTIVE HEAT TRANSFER FROM A FINE WIRE
F. C. Hurlbut Jan. 1964 10 p refs
(Sponsored in part by ONR)
(P-2843; AD-429109)

The analysis of Lees and Liu of thermal conductive heat transfer from a fine wire is extended to include arbitrary values of the thermal accommodation coefficient, α. The implications for experimental studies of α are examined with particular reference to the criterion for the applicability of free molecule flow theory in interpreting results. Author

N64-20131 Little (Arthur D.) Inc., Cambridge, Mass.
METHODS FOR LOW POWER TEMPERATURE CONTROL Third Quarterly Report, 1 Nov. 1963-31 Jan. 1964
Igor A. Black and John Peterson [1964] 42 p
(Contract DA-36-039-AMC-02207(E))
(AD-437496)

An investigation is discussed of methods, techniques, and devices by which the temperature of a quartz crystal can be maintained, with a minimum of power, at a nominal operating temperature over environmental temperature extremes. Second-order effects applicable to the design of low-power crystal ovens, are included. End products resulting from the study are three types of ovens: a 3-cubic-in., 500-mw-oven (Type J6) requiring accessibility to the crystal and operating at +75° C ±1° C over a −55° C to +60° C ambient; a 3-cubic-in., reduced power, sealed oven (Type K6G) with similar operating requirements; and a 4-cubic-in., 250-mw-oven (Type L6) requiring accessibility to a chamber capable of housing two crystals and operating at 0° C ±1° C over a −55° C to 0° C ambient. Author

N64-20200* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
RE-ENTRY HEAT CONDUCTION OF A FINITE SLAB WITH A NONCONSTANT THERMAL CONDUCTIVITY
William R. Wells Repr. from AIAA Journal, v. 2, no. 2, Feb. 1964 p 379-381 refs
(NASA RP-167)

The intense temperatures at the surface of a space vehicle may, in some instances, alter the thermal conductivity of the layers of the skin below the surface. This analysis presents, as a first approximation to the problem, a closed-form solution for the case of a thermal conductivity that varies linearly with distance below the surface. A convective heat input at the surface, which is exponential in time, is assumed. The results should apply for the initial phases of entry in which the entry velocity and angle are nearly constant. Author

N64-20284* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
A CORRELATION OF FILM-BOILING HEAT-TRANSFER COEFFICIENTS OBTAINED WITH HYDROGEN, NITROGEN, AND FREON 113 IN FORCED FLOW
Uwe H. von Glahn Washington, NASA, May 1964 45 p refs
(NASA TN D-2294) OTS: $1.25

A correlation study is made of some limited experimental film-boiling heat-transfer coefficients obtained from forced-flow boiling heat-transfer research with liquid hydrogen, nitrogen, and freon 113 as the working fluids. The data studied herein were all obtained with upward flow through electrically heated circular tubes. Correlation is obtained by the development of a relation between a film-vaporization parameter and a function consisting of a ratio of an experimental Nusselt number modified by a two-phase correlation factor to a calculated turbulent vapor-phase Nusselt number. The film-vaporization parameter includes the heat flux measured downstream of the point along the tube at which transition from nucleate to film boiling is initiated (burnout location), the latent heat, and the fluid quality at the burnout location. The experimental Nusselt number is expressed in terms of the saturated vapor thermal conductivity. Author

N64-20295* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FREE-FLIGHT INVESTIGATIONS OF SUBLIMING ABLATORS AND TRANSPIRATION COOLING AT HYPERSONIC VELOCITIES
Thomas E. Walton, Jr., Bernard Rashis, and Clyde W. Winters *In* AIAA Vehicle Design and Propulsion [1963] p 115-119 refs (See N64-20292 13-04)
AIAA: $5.00 members, $10.00 nonmembers

The results of several free-flight investigations, in which the thermal protection was provided by either a subliming ablator or by transpiration cooling, are discussed. The flight-test regime covered an altitude band from about 177,000 ft to 25,000 ft, and peak velocities ranged from 3,900 fps to

22,200 fps. The similarities between subliming ablators and transpiration cooling are described, and it is shown how the effectiveness of ablation materials can be predicted accurately from transpiration data. This analytical procedure permits direct comparison of the two types of heat protection and allows extrapolation, based on low-speed transpiration data, of ablation material effectiveness to supercircular velocities. Author

N64-20323 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
EXPERIMENTAL STUDY OF CONTACT HEAT EXCHANGE
M. E. Aerov et al 15 Apr. 1964 12 p refs Transl. into ENGLISH from Kholodil. Tekhn. (Moscow), v. 40, no. 1, 1963 p 37-40
(RSIC-162; AD-437961)

Experiments were conducted on packed evaporators and condensers. Systems studied were an aqueous solution of calcium chloride–boiling propane and an aqueous solution of calcium chloride–boiling butane. The solubility of propane in water is very small. Replacing ammonia with propane increases the cooling conductivity of the device. The comparative characteristics of ammonia and propane cooling cycles are tabulated. These studies were helpful in the design of devices for the separation of cracking gas. A.W.

N64-20342 General Dynamics/Fort Worth, Tex.
CENTAUR LIGHTWEIGHT INSULATION PANELS, COMPONENT TESTS, PHASE III Test Report
R. W. Soady 15 Apr. 1964 29 p
(Contract AF 33(657)-11214)
(MR-SS-014; AD-436734)

The purpose of this test program was to determine the load carrying capability of each configuration of the lightweight insulation panels, and to compare the stress distribution of the panels with that calculated for the room-temperature condition. This latter operation is of particular importance in the tunnel areas where, due to the geometry and large deflections that occur, the actual state of stress is critical. By determining the relationship between the predicted and actual stress distribution for these panels, the state of stress for the operating conditions can be more accurately predicted. Dial gages were used for deflection measurements on the tunnel sections to determine the actual stiffness of the part. The panels were loaded incrementally to failure. Strain gage and deflection measurements were recorded at each load increment. The panels were cut shorter than the desired length, requiring the use of bonded aluminum doublers on the ends of the tunnel sections, through which to apply the load. Author

N64-20343 General Dynamics/Fort Worth, Tex.
CENTAUR LIGHTWEIGHT INSULATION PANELS, DESIGN ALLOWABLES, PHASE II Test Report
G. H. Hayward, W. M. Beatty, and R. E. Bryant 15 Apr. 1964 60 p refs
(Contract AF 33(657)-11214)
(SSR-1-63; AD-436733)

The Centaur lightweight insulation panel construction is basically a glass reinforced plastic honeycomb sandwich where the core cells are filled with a low density insulating foam. The laminating resin is a phenolic, and the core to skin adhesive is an epoxy-phenolic. The purpose of this test program was to determine the strength of the sandwich composite and its components to establish design allowable stresses. The mechanical properties of the insulation panel composite and its component parts through the temperature range of −423 through +550° F were determined, and the results of these tests indicated that there is sufficient margin between the typical test average and the design requirement to insure satisfactory performance of the panels to ultimate design loads and temperatures. Author

N64-20502 Rocketdyne, Canoga Park, Calif.
HEAT TRANSFER FROM A HOT SODIUM SPRAY IMPINGING ON A VERTICAL PLATE Research Report No. 63-36
W. H. Nurick and J. D. Seader Nov. 1963 49 p

A program to develop an empirical correlation for determining heat transfer from a hot sodium spray impinging on a vertical plate is described. The major variables were droplet size, angle of impingement, physical properties, flowrate per unit area, and impingement velocity. At 1,000° F, results indicated that the heat transfer coefficient varied from about 275 to 725 Btu/hr-sq ft-F when the sodium droplet impinging velocity was varied from about 150 to 250 ft/sec. This corresponded to a variation in sodium flowrate per unit area of about 0.68 to 4.90 lb/sec-sq ft. A correlation of the heat transfer data was developed using conventional dimensionless parameters. The resulting equation for sodium was: $Na = 0.00334 (Re\ Co)^{0.407}$ Author

N64-20516 Bureau of Mines, Berkeley, Calif.
THERMODYNAMIC DATA FOR COLUMBIUM (NIOBIUM) CARBIDE
L. B. Pankratz, W. W. Weller, and K. K. Kelly 1964 13 p refs
(BM-RI-6446)

The heat capacity of columbium (niobium) carbide (CbC) was measured over the temperature range from 51° to 298° K, and the entropy at 298.15° K was evaluated. Also, the heat content above 298.15° K of columbium carbide was measured to 1,800° K. The results were combined with the known heat of formation at 298.15° K to obtain values of the heat and free energy of formation over the temperature range from 298.15° K to 2,000° K. Author

N64-20575 IIT Research Inst., Chicago, Ill.
VARIABLE THERMAL-CONTROL COATINGS
Sidney Katz and E. H. Tompkins 10 Apr. 1963 22 p refs
(Rept. 63-114CX)

A program is outlined for the analysis and testing of mechanisms suitable for thermally controlled spacecraft coatings having reflectivities that increase either with time or with rise in temperature. Three systems based on the Christiansen filter principle, slow segregation of a white solid dissolved in a plasticizer, and unusual phase systems such as liquid crystals are proposed for the first work. Tests under space-simulated conditions will be conducted. Author

N64-20604* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
THE APPLICATION OF TEMPERATURE RATE MEASUREMENTS TO THE DETERMINATION OF THERMAL EMITTANCE
William M. Hall 15 Apr. 1964 13 p refs
(NASA Contract NAS7-100)
(NASA CR-56037; JPL-TR-32-596) OTS: $1.60 ph

Two calorimetric techniques are evolved to facilitate accurate measurement of the hemispherical emittance of spacecraft temperature-control surfaces at room temperature. Emittance is determined in a short period of time without using high-precision temperature-control apparatus. The first technique, the rate-equation method, uses a heating curve and a cooling curve to obtain emittance without the use of the heat-capacity value for the test surface. The second technique, the iteration method, uses data from several arbitrarily induced heating and

cooling curves in an iteration procedure where the data converge, within a 3-hr observation period, to a set of steady-state power-temperature values. Results of applying the preceding techniques to surfaces of low emittance and of moderate emittance are presented together with data on the accuracy and dispersion of the measurements. Some values of emittance obtained from long-term temperature-equilibrium tests are given for comparison. Measurements are made on a heated 6- x 6-in. flat sample placed adjacent and parallel to a liquid-nitrogen-cooled flat receiver plate, which views the sample hemispherically. The test apparatus is described. Author

N64-20624 Boeing Scientific Research Labs., Seattle, Wash. Solid State Physics Lab.

THERMAL TRANSIENTS RESULTING FROM INSTANTANEOUS HEAT SOURCES IN A SOLID WITH TEMPERATURE DEPENDENT THERMAL PROPERTIES

Joachim C. Erdmann and James A. Jahoda Oct. 1963 18 p refs

(DI-82-0310)

The nonlinear differential equation for heat conduction in a medium having temperature-dependent thermal conductivity and heat capacity is solved numerically for an experimentally important case. This case is the liberation of heat by an instantaneous plane source in an infinite, linear solid whose thermal parameters are assumed to have the temperature dependence of real alloys at cryostatic temperatures. It is found that the temperature transients for this case do not differ substantially from those of a solid having temperature-independent thermal parameters, if the heat source does not exceed a certain strength whose value is derived. This result provides the basis for easier quantitative calorimetry of instantaneous heat sources activated by discontinuous plastic flow in alloys at helium temperatures. Author

N64-20637 Boeing Scientific Research Labs., Seattle, Wash.

CALORIMETRY OF INSTANTANEOUS HEAT SOURCES ARISING FROM PLASTIC TENSILE DEFORMATION AT LOW TEMPERATURES

Joachim C. Erdmann, and James A. Jahoda Oct. 1963 41 p refs

(DI-82-0311)

A method is described for measuring the thermal energy leaving a metal specimen under homogeneous and discontinuous plastic tensile deformation. It is based on the observation of thermal transients associated with the heat release. The evaluation procedure accounts for the influence of the inertia of the thermometers. Although the method is not restricted to low temperatures, it is most suitable at helium temperatures, at which other means of calorimetry are less favorable. Author

N64-20644* Denver U., Colo. Denver Research Inst.

SUBCOOLED BOILING IN A NEGLIGIBLE GRAVITY FIELD Status Report No. 6

Thomas R. Rehm and Gary E. Warner 15 Apr. 1964 15 p

(NASA Grant NsG-143-61)

(NASA CR-56013)

The boiler was modified to allow a larger field of view of the heating surface. The lighting system for the camera was modified; a system of commercial flood lamps and "sunguns" were used. Results of test runs indicate that there are at least three types of bubbles or bubble patterns present during the boiling process: oscillating bubbles, continuous growth and decay bubbles, and multiple bubble groups. A bubble cannot be adequately described and analyzed as a sphere or an equivalent spherical volume. The bubble shape and, therefore, the volume are a function of time and must be treated as a point value. Bubbles do not separate at R_{max}. The bubble will not separate if the heat transfer out of the bubble interface is equal to or greater than the heat transfer into the bubble from the surface and superheat layer. The bubble will become stagnant, begin to condense, or become an oscillator-type bubble. Bouyant- and intertia-force equations are presented for analyzing bubble mechanics. Heat-transfer data obtained indicate a general trend of the heat-transfer coefficient increasing with a decrease in subcooling for a constant heat flux. I.v.L.

N64-20695 Los Alamos Scientific Lab., N. Mex.

PARTICLE-TO-GAS HEAT TRANSFER IN FLUIDIZED BEDS

A. C. Juveland, H. P. Deinken, and J. E. Dougherty 15 May 1964 30 p refs

(Contract W-7405-ENG-36)

(LA-3061)

Particle-to-gas heat-transfer measurements were made in shallow beds of ZrC particles fluidized by helium or argon. The particles were heated by induction to temperatures as high as 1,150° C. Transfer coefficients were obtained using a steady-state system from measurements of the temperature of the solids and the gas temperature downstream from the bed. Four different average particle sizes were used, ranging from 385μ to 1420μ. The static bed depth was varied from 0.18 to 1.31 cm. Reynolds numbers of from 0.23 to 84 were investigated. A qualitative argument for the low heat-transfer coefficients in fluidized beds is presented. Author

N64-20743* General Electric Co., Philadelphia, Pa. Re-entry Systems Dept.

SELECTION OF A TEMPERATURE CONTROL SYSTEM FOR A MARS PROBE

Clark V. Dohner 10 Jan. 1963 26 p refs

(NASA Contract NAS7-100; JPL-950226)

(NASA CR-56178) OTS: $2.60 ph

This report presents the thermal design study for a Mars-probe entry vehicle. Four types of temperature control systems are considered: (1) α/ϵ coating with solar cells (α is the solar absorptivity of the exterior of the vehicle; ϵ is the emissivity of the exterior of the vehicle); (2) α/ϵ control; (3) superinsulation with solar cells; and (4) radioisotope heat generation. The α/ϵ coating system is a temperature control system that makes use of coatings on the shield and capsule to limit the change in temperature of the capsule as the solar flux varies during the journey from Earth to Mars. The α/ϵ control system would require the placement of a magnesium "clamshell" around the outside of the vehicle. Copper tubing filled with a liquid Freon or propane then would be wound around the outside of this clamshell and in intimate thermal contact with it. Contraction or expansion of the liquid due to temperature changes would actuate open–closed type shutters to increase or decrease the α/ϵ value so that an average vehicle temperature of approximately 80° F would be maintained. The superinsulation system consists of superinsulation wrapped around the outside of the vehicle with solar cells affixed to it. The radioisotope heat generation system controls the capsule temperature through the use of a radioisotope thermoelectric generator (RTG) unit. Based on a preliminary investigation the RTG type of system appears to be quite desirable. I..v.L.

14 HUMAN BEHAVIOR

Includes crew training and evaluation; piloting; and psychological factors. *For simulators see*: 10 Facilities, Research and Support. *For related information see*: 16 Life Sciences.

N64-20318 Human Factors Research, Inc., Los Angeles, Calif.
THE EFFECT ON THE LEVEL OF VIGILANCE OF AN ADJACENT SECONDARY VIGILANCE TASK Technical Report 750-4
J. O'Hanlon, Jr. and E. A. Schmidt Apr. 1964 27 p refs
(Contract Nonr-4120(00))
(AD-437334)

The purpose of this study was to determine whether performance of a main visual vigilance task could be enhanced by presenting observers with knowledge of their performance of an adjacent and concurrent secondary visual vigilance task. Observers were told that adequate or inadequate performance of the secondary task revealed the adequacy of their performance of the main task. A preliminary experiment involving 16 observers established criteria of adequate and inadequate performance for the main experiment. During the main experiment, 16 observers undertook a control condition and an experimental condition in which knowledge of the secondary task performance was supplied. Another 16 observers undertook the same control condition and an experimental condition in which the same secondary display was presented but signals were ignored. Performance of a main visual vigilance task is impaired by an adjacent visual vigilance display on which occasional secondary signals are presented. This is true regardless of whether instructions indicate that secondary signals are to be responded to or ignored. Author

N64-20329 Naval Air Development Center, Johnsville, Pa. Aviation Medical Acceleration Lab.
PSYCHOLOGICAL PROBLEMS IN DISORIENTATION Report No. 8
Randall M. Chambers 31 Dec. 1963 32 p refs
(NADC-MA-6321; AD-432968)

This report reviews and summarizes research on the varied aspects of disorientation encountered by man during space travel. Disorientation refers to false sensations, incorrectly sensed cues, misperception, and inappropriate responses to stimuli resulting in false perceptual frames of reference. Time disorientation and visual disorientation are evaluated for astronauts during prolonged space flight. In considering disorientation in position and motion, the role of the visual system, the labyrinthine system (vestibular apparatus of the inner ear), and the extralabyrinthine system (peripheral pressure, muscle, and posture senses) are summarized. Illusions of position and motion are described, and their involvement in space flight operations is discussed. Once the stimuli, responses, and basic physiological and psychological mechanisms are understood for specific space flight missions, techniques of selection, adaptation, training, and human engineering may be used to increase man's ability to tolerate the stress and to perform reliably in any spacecraft. Author

N64-20409 Human Factors Research, Inc., Los Angeles, Calif.
THE USE OF REFERENCE SIGNALS IN A VISUAL VIGILANCE TASK. II. REFERENCE SIGNALS DISPLAYED WHEN DEMANDED AND WHEN ARBITRARILY PROGRAMMED Technical Report 750-2
C. H. Baker and J. O'Hanlon, Jr. Dec. 1963 31 p refs
(Contract Nonr-4120(00))
(AD-428282)

The purpose of this experiment was to determine whether or not performance on a visual vigilance task is aided by displaying reference signals adjacent to the display constituting the vigilance task. Four conditions were studied with 24 observers employed in each. In a control condition the adjacent reference display was never employed. In a second condition, the observers could demand activation of the reference display whenever they wished, and reference signals were generated during the activation period. In a third condition, the experimenter activated the reference display at arbitrarily chosen intervals, and reference signals were generated during the activation period. In a fourth condition, the experimenter activated the reference display at arbitrarily chosen intervals but reference signals were never generated. Neither the reference signals demanded by the observer nor the reference signals arbitrarily programed by the experimenter were an aid in improving the general level of detection performance in the vigilance task. Author

N64-20559 Aerospace Industries Assn. of America, Inc., Washington, D.C. Electronic Equipment Technical Committee
RELIABILITY ASPECTS OF HUMAN ENGINEERING BIBLIOGRAPHY
D. Meister (Gen. Dynamics/Astronautics) Apr. 1964 21 p refs
(EETC-7, Rev. A) Available from Natl. Standards Assn., Inc.: $1.00

This bibliography lists publications dealing with reliability aspects of human engineering, under the following categories: (1) a general description of human engineering; (2) human factors and reliability; (3) human error and human-initiated equipment failures; (4) the prediction of man–machine reliability or the integration of human factor aspects into new system design; (5) human factors and the maintainability aspects of reliability; and (6) the evaluation of the reliability of man–machine performance. Short abstracts accompany most of the reports. I.v.L.

N64-20591* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DECK MOTION SIMULATOR PROGRAM HORIZONTAL SINUSOIDAL OSCILLATION: EFFECTS UPON PERFORMANCE OF STANDING WORKERS
J. S. Seeman and R. B. Williams 3 Mar. 1964 54 p refs
(NASA TM X-53011) OTS: $5.60 ph

An experiment was performed to assay effects of horizontal linear sinusoidal oscillation of two discrete frequencies (0.33 cps and 0.80 cps) and one amplitude (±7 inches) upon psychomotor performance of standing personnel. No significant differences were found in performance of the tasks at 0.33 cps. Significant performance decrements were found at 0.80 cps. Implications of results are discussed pertaining to Saturn V servicing. Author

N64-20597* Alto Scientific Co., Inc., Palo Alto, Calif.
VOICE/CARDIAC SOUNDS UNDER STRESS Final Report
28 Aug. 1963 50 p
(NASA Contract NAS2-1394)
(NASA CR-53501) OTS: $4.60 ph

The objectives of the study were to determine if Alto speech recognition detect circuits can measure changes in a pilot's speech under varying environmental g stress, and to make a preliminary evaluation to determine whether peak power asymmetry measuring techniques show promise in obtaining a sophisticated phonocardiogram, particularly as related to measuring change in cardiac sounds under varying g stress. Of the

large amount of data taken, the most suitable for preliminary reduction was at the higher 6 g level; and because of constraints in the accumulation of data, no attempt was made to reduce cardiac data from actual centrifuge runs beyond the conclusion that the heart sounds do display asymmetry. Limited laboratory data may indicate a relationship between cardiac asymmetry and respiration. R.T.K.

N64-20598* Columbia U., New York, N.Y. Electronics Research Labs.
DESIGN AND IMPLEMENTATION OF PHYSIOLOGIC MONITORING SYSTEMS Semi-Monthly Progress Letter MPL-1/191, May 23–Jun. 15, 1962
L. B. Lambert [1962] 3 p
(NASA Contract NAS2-878)
(NASA CR-53652) OTS: $1.10

The object of this project is to develop the required instrumentation for the monitoring of experimental animals' physiological behavior in the experimental balloon flights, in order to observe the effects of cosmic radiation. The final design for the flight model of the blood flowmeter was determined, and a working model was tested successfully. A number of amplifiers are required for each flight to service the various instrumentation channels as well as the life-support system. Several types of amplifiers were evaluated; the Telemedics amplifier was found to be acceptable. An electromyogram integration technique was successfully tested; therefore the respiration-rate signals can be recorded and can be considered as reliable data. Capsule wiring was designed. R.T.K.

N64-20730* Naval School of Aviation Medicine, Pensacola, Fla.
VESTIBULAR SICKNESS AND SOME OF ITS IMPLICATIONS FOR SPACE FLIGHT
Ashton Graybiel 1963 33 p refs Presented at the 11th Ann. Sci. Meeting of the Houston Neurological Soc. and the Dept. of Neurology, Baylor U. Coll. of Med., Houston, Tex., 14–16 Mar. 1963
(NASA Order R-47)
(NASA CR-53958) OTS: $3.60 ph

Recent investigations dealing with functional disturbances of vestibular origin are summarized, and their relevance to manned space flight is indicated. These studies employed a constantly rotating or counter-rotating environment and used normal human subjects, as well as those with vestibular defects. The report deals with (1) the symptomatology resulting from brief exposure to different force environments, and (2) the time course of the appearance and disappearance of symptoms with prolonged exposure in the slow rotation room. R.T.K.

15 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gauges; sensors and transducers; and telescopes and cameras. *For related information see*: 06 Auxiliary Systems; 08 Communications; 09 Electronics; and 22 Navigation and Guidance.

N64-20000* McGill U., Montreal (Canada)
PHOTOGRAPHY OF THE WESTERN SAHARA FROM THE MERCURY MA-4 SATELLITE
A. Morrison [1964] 8 p
(NASA Contract NASr-140)
(NASA CR-53505) OTS: $1.10 ph

The space photographs taken from the Mercury M-4 satellite show the same types of distribution as would air photos of the western Sahara, namely rock-type, structure, landforms, and drainage pattern, and can be interpreted through the variation of the same factors: tone, texture, pattern, and shape as seen in plan. The third dimension cannot be used much for interpretation because the stereo-effect obtainable is small, but is to some extent replaced by color. Areal and linear features up to hundreds of kilometers in extent are obvious. Subtle tone and color changes can be picked out, which would be lost in a mosaic of the hundreds of air photos needed to cover the area. Moreover they provide a uniform coverage across political boundaries. In the same way that a detailed survey made from aerial photos is checked by ground work in critical areas, a wider study based on these space photographs would be checked by selective use of aerial photographs or field work. The full interpretation of these photos requires study by two groups, one group expert on the Sahara and using the photos to piece together local studies they have made; the other group without preconceived ideas about the Sahara and viewing the photos in a worldwide context. Author

N64-20019* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
APPARATUS FOR STRESS-RUPTURE TESTING OF FILAMENTS IN A CONTROLLED ENVIRONMENT
R. W. Jech, R. H. Springborn, and D. L. Mc Danels Repr. from Rev. Sci. Instr., v. 35, no. 3, Mar. 1964 p 314–315 refs
(NASA RP-165)

A description is given of a stress-rupture apparatus designed and built for testing filaments and wires having a diameter of 20 mils or less in a controlled atmosphere to prevent oxidation. Four tests may be run simultaneously at different stresses and temperatures (to 1,427° C), and the stress-rupture life of each filament can be measured independently and automatically. IAA

N64-20088 California Inst. of Tech., Pasadena Quantum Electronics Lab.
AN INTERFEROMETRIC MEASUREMENT OF INDEX OF REFRACTION Scientific Report No. 5
Michael S. Shumate 13 Mar. 1964 77 p refs
(Contract AF 19(604)-8052; JPL Contract 97479)
(AFCRL-64-175; AD-437768)

Of the several methods for measuring the index of refraction of solid optical materials, only one, the minimum deviation method, can conveniently be used for materials whose refractive index exceeds 1.8, and requires that a large prism of the optical material be constructed. A method for measuring index of refraction is presented, which requires a thin flat plate of the optical material, and is unlimited in the range of refractive index it can cover. A two-beam interferometer is used to determine the optical path length through the flat plate by tipping away from normal incidence through a measured angle. It may be used in the visible portion of the spectrum directly, or extended to other spectral regions using a suitable detector, and is highly accurate. An error analysis is presented, which shows that sample plates having a small wedge angle may be used with only slight deterioration in the accuracy. An analysis of methods for using an interferometer to determine gradients of refractive index as well as refractive index dispersion is also presented. Author

N64-20104 ACF Industries, Inc., Paramus, N.J. ACF Electronics Div.
L-BAND RADIOMETER TYPE 507 Scientific Report No. 2
Zenon Bilyk 9 Mar. 1964 37 p refs
(Contract AF 19(604)-8821)
(ACF-AR-1679; AFCRL-64-252; AD-438221)

An L-band radiometer, consisting of the following main components, is described: (1) the antenna; (2) the temperature telemetry output; (3) the reference load; (4) the SPDT RF switch; (5) the preselector; (6) the balanced mixer; (7) the local oscillator; (8) the IF amplifier; (9) the second detector (a square law detector); (10) the audiofrequency amplifier; (11) the coherent detector; (12) the multivibrator; and (13) the output integrator. Also, the power supply and the radiometer sensitivity are discussed, and a diagram of the radiometer circuitry is presented. I.v.L.

N64-20111 Cutler-Hammer, Inc., Deer Park, N.Y. Airborne Instruments Lab.
FREQUENCY MULTIPLIER Second Quarterly Progress Report, 1 Oct. 1963-31 Dec. 1963
J. J. Taub, G. P. Kurpis, and J. W. Lyons [1963] 37 p
(Contract DA-36-039-AMC-03196(E))
(AD-433798)

The X-band source described in detail in this report consists of a transistor oscillator, transistor quadrupler, filter, transistor sextupler, filter, transistor tripler, transistor power amplifier, and two varactor quintuplers. The multiplier chain is of modular construction for ease of testing and troubleshooting. The results of optimizing each unit in the multiplier chain are given, as well as data on the individual units. Experimental results on the 10.65 to 21.3 Gc doubler and the 25 to 50 Gc doubler are also given. Author

N64-20123 Bhimani Research Associates, Lexington, Mass.
MULTIDIMENSIONAL MODEL FOR AUTOMATIC SPEECH RECOGNITION Final Report
B. V. Bhimani 14 Feb. 1964 283 p refs
(Contract AF 19(628)-2766)
(AFCRL-64-85; AD-437324)

The purpose of this study is to provide a theoretical basis for a general purpose speech recognizer. The research was focused on the nature of normal speech, distinguishable from discrete articulation by the continuous movement (in normal speech) of articulators from one position to another; as a result, sounds in continuous speech are more likely to modify the production of surrounding sounds than they are in discrete speech. Linguistic examples and theories of sound change were studied. A body of rules for sound change or euphonic combination was derived and their applicability to English tested. These rules represent an error-correcting code to restore omitted or indefinite word boundaries and/or to restore the orthographic phone classes altered in continuous speech. High-quality recordings of continuous speech samples were made. Both original data and previously published data were subjected to acoustic analysis of minute portions of the speech waveform. These measurements both suggested and justified a principle of segmenting speech, to be used with the representations of speech sounds in the multidimensional model and the above mentioned error correcting code, to delineate a new conception of a general purpose recognizer. Author

N64-20134 General Dynamics/Astronautics, San Diego, Calif. Space Science Lab.
MEASUREMENT OF THE SLIT FUNCTION OF A SMALL PRISM MONOCHROMATOR Technical Report
M. L. Streiff and C. C. Ferriso Mar. 1964 57 p refs
(Contract Nonr-3902(00); Proj. Defender)
(GDA-DBE64-013; AD-435850)

The slit function of a small prism monochromator has been measured for equal entrance and exit slits with an NaCl prism in two spectral regions using relatively wide slits. Two different methods employing narrow sources have been used to obtain the data: (1) using a variable wavenumber monochromator source or (2) by scanning a fixed wavenumber (filter) source. The results from the two methods are essentially the same. The experimental results show good agreement with shapes and half intensity widths calculated from simple theory with wide slit widths; however, the triangular form is nonsymmetrical as a result of variation of dispersion. Observed rounding at the base and at the peak of the triangle is discussed briefly. Author

N64-20148 Controls for Radiation, Inc., Cambridge, Mass.
IMPROVEMENT OF PHOTOMULTIPLIER RESPONSE AND DEVELOPMENT OF A DEVICE FOR MEASUREMENT OF kev AURORAL ELECTRONS Final Report
Richard C. Mc Call and Alfred C. Jasins 27 Apr. 1964 27 p refs
(Contract AF 19(628)-2910)
(AFCRL-64-166; AD-438427)

The limitations and capabilities of various detectors, especially photomultipliers are reviewed. Two methods, use of constant response fluors and use of choppers, are suggested for improvement of photomultiplier responses. A new type of detector is discussed and suggested for further development. The use of an LiF thermoluminescent dosimeter for detection of electrons is described. Experimental work leading to the present functioning system is presented. The response of this system to Co^{60} gamma rays, uranium beta rays, and to 7 kev electrons is given. Author

N64-20152 Illinois U., Urbana Coordinated Science Lab.
DYNAMIC STABILITY OF THE RESONANT CIRCUIT ELECTRICALLY SUPPORTED GYRO
Don R. Allen Aug. 1963 46 p refs
(Contract DA-36-039-SC-85122)
(R-166; AD-427032)

The electrically supported gyro is a free, two-axis gyro employing a spherical metal rotor, shielded from stray magnetic fields and supported without physical contact in ultrahigh vacuum by servocontrolled high-voltage electric fields. The rotor is initially accelerated by induction motor techniques but spins freely with virtually no friction during gyro operation. An analysis is made of the static and dynamic properties of a unique rotor support servo called the resonant-support servo, consisting basically of series resonant circuits formed by connecting a voltage generator and an inductor in series with the capacitance of each support electrode and the rotor. By driving each resonant circuit with a sufficiently high voltage at a frequency higher than its resonance, the rotor can be supported arbitrarily close to the center of the spherical cavity formed by the electrodes. Because the resonant-support servo is dynamically unstable, three general methods of stabilizing the servo are described and analyzed. Author

N64-20176 Ohio State U. Research Foundation, Columbus Inst. of Geodesy, Photogrammetry and Cartography
GEODETIC EXPERIMENT BY MEANS OF A TORSION BALANCE Scientific Report No. 3
Ivan I. Mueller, Orlando Holway III, and Robert B. King, Jr. Dec. 1963 76 p refs
(Contract AF 19(628)-2771)
(Rept. 30; AFCRL-64-131; AD-438967)

The torsion balance offers several possibilities in geodetic applications of which the most important are: (1) the interpolation of deflections of the vertical and of geoid undulations between reference stations, where gravity material is not sufficient; (2) the determination of the geopotential values in a given area for the purpose of leveling reductions; (3) the determination of the radius of curvature of the plumb line for reducing astronomical coordinates to the geoid; and (4) to investigate curvature properties of the equipotential surface for more accurate base line reductions to the ellipsoid of reference. Author

N64-20184 ACF Industries, Inc., Paramus, N.J. Electronics Div.

DESIGN OF A UHF RADIOMETER FOR PLASMA MEASUREMENTS Scientific Report No. 1

Zenon Bilyk and Stephen Scrupski 9 Mar. 1964 31 p refs (Contract AF 19(604)-8821)

(ACF-AR-1678; AFCRL-64-251; AD-438222)

An experiment is proposed whereby the electromagnetic noise that is radiated from the plasma sheath enveloping a reentry vehicle can be measured. A radiometer was investigated that consists of a tuned superheterodyne receiver and associated low-frequency circuitry for the detection of the switched noise temperature, which compares the antenna noise to a reference resistor noise level. Experimental results show a sensitivity of 52° K, which is sufficient for the measurement of the high-temperature plasma noise. A crystal video radiometer was also investigated, but was found to have poor sensitivity in comparison to the superheterodyne circuit. R.T.K.

N64-20214 Joint Publications Research Service, Washington, D.C.

REMOTE-CONTROLLED CUP ANEMOMETER WITH HIGH-FREQUENCY DATA UNIT

A. I. Merzheyevskiy *In its* Turbulent Diffusion in the Surface Layer of the Earth's Atmosphere 6 May 1964 p 193–196 (See N64-20201 13-21) OTS: $5.00

An explanation is given of the operation and circuitry of an anemometer used for measuring wind speeds. This anemometer uses remote control and a high-frequency data unit having a semiconductor triode. This instrument is free of the deficiencies characteristic of inductor and contact-cup anemometers. C.L.W.

N64-20215 Joint Publications Research Service, Washington, D.C.

DEVICE FOR THE AUTOMATIC RECORDING OF THE VERTICAL PROFILE OF THE WIND

B. Ya. Tolstobrov *In its* Turbulent Diffusion in the Surface Layer of the Earth's Atmosphere 6 May 1964 p 197–205 refs (See N64-20201 13-21) OTS: $5.00

A description is given of an anemogradientograph that permits automatic plotting of the vertical distribution of the windspeed gradient and the deviation of the wind profile from the given profile. The device consists of five photoelectric windspeed data units with a mechanical differential reducer, a pulse storage unit, and a recorder. These components are described, and an electrical line diagram is given of an anemogradientograph. The operating mechanisms of the instrument are outlined. C.L.W.

N64-20216 Joint Publications Research Service, Washington, D.C.

A STATIONARY AUTOMATICALLY BALANCING RECORDING TEMPERATURE GRADIENT METER

L. G. Kachurin, B. Ya. Tolstobrov, V. M. Ushakov, and N. S. Yalynychev *In its* Turbulent Diffusion in the Surface Layer of the Earth's Atmosphere 6 May 1964 p 206–219 refs (See N64-20201 13-21) OTS: $5.00

An automatically balancing recording temperature-gradient meter is described. This meter was developed for recording the vertical distribution of temperature in the surface layer of the atmosphere to heights of 300 meters, under stationary conditions. The instrument is based on electronic, automatically balancing bridges. Diagrams are shown of a simplified circuit of the device, and balancing of the circuit is discussed, along with the design of the instrument. C.L.W.

N64-20217 Joint Publications Research Service, Washington, D.C.

AN UNBALANCED AUTOMATIC TEMPERATURE GRADIENT METER FOR FIELD USE

L. G. Kachurin, B. Ya. Tolstobrov, V. M. Ushakov, and N. S. Yalynychev *In its* Turbulent Diffusion in the Surface Layer of the Earth's Atmosphere 6 May 1964 p 220–231 ref (See N64-20201 13-21) OTS: $5.00

This article describes an instrument designed for the remote control automatic recording of the half-sum and differences of temperatures in the surface layer of the air to a height of 30 to 50 m. It is based on the principle of an unbalanced metal resistance thermometer with a mirror magnetoelectric galvanometer as a recorder of the bridge unbalance signal. A paper-movement mechanism with discretely moving photo paper is used for recording the position of the galvanometer mirror. Discrete movement is insured by an electric motor, connected through a system of toothed gears with a Maltese cross. Author

N64-20218 Joint Publications Research Service, Washington, D.C.

AN AUTOMATICALLY RECORDING DIFFERENTIAL BALANCE METER

B. Ya. Tolstobrov *In its* Turbulent Diffusion in the Surface Layer of the Earth's Atmosphere 6 May 1964 p 232–241 refs (See N64-20201 13-21) OTS: $5.00

Two instruments used for measuring the radiation balance of natural surfaces are described. One is the standard balance meter used in networks of stations and on expeditions. The other is the differential balance meter, used for measurement of the radiation balance and the total flux of radiation entering the atmosphere from above or below. These instruments are compared by presenting their advantages and shortcomings. R.T.K.

N64-20219 Joint Publications Research Service, Washington, D.C.

AUTOMATIC INTEGRAL FLUCTUATION METERS

L. G. Kachurin *In its* Turbulent Diffusion in the Surface Layer of the Earth's Atmosphere 6 May 1964 p 242–246 (See N64-20201 13-21) OTS: $5.00

The term "automatic integral fluctuation meter" (AIP) is applied to those instruments that automatically determine the principal integral structural characteristics of aerophysical values. This article discusses AIP that are continuous-action computers. Two types of integral fluctuation meters that can be used for practical purposes are described—those with a fixed averaging interval, and those with a continuously changing averaging interval. R.T.K.

N64-20220 Joint Publications Research Service, Washington, D.C.

ELECTRONIC ANEMO-FLUCTUATION METER

M. L. Gol'denberg *In its* Turbulent Diffusion in the Surface Layer of the Earth's Atmosphere 6 May 1964 p 247–253 (See N64-20201 13-21) OTS: $5.00

An electronic variant of an automatic integral fluctuation meter with a fixed averaging interval is described. The instrument is designed for the determination of the structural parameters of flow direction in the vertical and horizontal planes. The principle of operation of the instrument, the basic recording circuit, and the basic analysis circuit are described. R.T.K.

N64-20222 Joint Publications Research Service, Washington, D.C.

INERTIA CHARACTERISTICS OF AIR CURRENT DIRECTION SENSORS

L. G. Kachurin and Ya. P. Popov *In its* Turbulent Diffusion in the Surface Layer of the Earth's Atmosphere 6 May 1964 p 259–269 refs (See N64-20201 13-21) OTS: $5.00

The developed method for determination of the inertia characteristics of airflow direction sensors, based for the most part on the method of investigation of the control surfaces of aircraft, makes it possible to select the optimal dimensions of the sensors when developing direction gages and to take into account their inertia errors when processing the measurement results. Author

N64-20224 Joint Publications Research Service, Washington, D.C.

STANDARD DESIGN OF A LOW-INERTIA HOT-WIRE RESISTANCE ANEMOMETER WITH TEMPERATURE COMPENSATION

L. G. Kachurin and Li Sang Keng *In its* Turbulent Diffusion in the Surface Layer of the Earth's Atmosphere 6 May 1964 p279–288 refs (See N64-20201 13-21) OTS: $5.00

A standard computation of the dependence of the sensitivity of the hot-wire resistance anemometer on the temperature of the medium is presented. Equations are included that show improvement in the operation of the anemometer when there is temperature compensation. The relative temperature errors of anemometers with and without compensation for different airflow velocities are presented, and the absolute errors for both cases are also given. In the case of the anemometer with compensation, the relative temperature error changes only slightly over a wide range of velocities. The absolute temperature error of a compensated anemometer is small. R.T.K.

N64-20225 Joint Publications Research Service, Washington, D.C.

A FIELD AUTOMATICALLY BALANCING RECORDING TEMPERATURE GRADIENT METER

B. Ya. Tolstobrov *In its* Turbulent Diffusion in the Surface Layer of the Earth's Atmosphere 6 May 1964 p 289–296 refs (See N64-20201 13-21) OTS: $5.00

A highly sensitive, automatically balancing, recording, temperature-gradient meter for field use was developed and is described. The instrument is designed on the principle of a metal resistance thermometer operating on direct current. It has a mirror magnetoelectric galvanometer as an indicator of imbalance of the bridge and a special electromechanical system as a recorder. The basic electric circuit of the balanced temperature gradient meter is included. R.T.K.

N64-20236 Radio Corp. of America, Princeton, N.J.

EFFECT OF MOUNTING-VARIABLES ON ACCELEROMETER PERFORMANCE

B. Mangolds *In* Defense Dept. Shock, Vibration and Assoc. Environ., Pt. 3 Mar. 1964 p 1–12 (See N64-20235 13-01)

Since an accelerometer must be mounted before it can be used, the mounting method has some effect on its performance. The various mounting methods were tested; some were acceptable and some were not. G.D.B.

N64-20237 Marine Engineering Lab., Annapolis, Md.

SURFACE FINISH EFFECTS ON VIBRATION TRANSDUCER RESPONSE

R. W. Miller *In* Defense Dept. Shock, Vibration and Assoc. Environ., Pt. 3 Mar. 1964 p 13–18 (See N64-20235 13-01)

An investigation is described to determine the effects of applied torque, surface finish, and surface flatness of transducers and mounting bases on vibration transducer sensitivity. Author

N64-20238 Ling-Temco-Vought, Inc., Dallas, Tex. Military Electronics Div.

CALIBRATION OF WATER COOLED HIGH TEMPERATURE ACCELEROMETERS

W. R. Taylor and C. D. Robbins *In* Defense Dept. Shock, Vibration and Assoc. Environ., Pt. 3 Mar. 1964 p 19–25 refs (See N64-20235 13-01)

This paper presents a specific method for calibrating a water-cooled high-temperature accelerometer. Topics discussed include heating device, fixture design, cooling requirements, instrumentation, and results obtained. Author

N64-20240 ENDEVCO Corp., Pasadena, Calif.

CALIBRATORS FOR ACCEPTANCE AND QUALIFICATION TESTING OF VIBRATION MEASURING INSTRUMENTS

R. R. Bouche and L. C. Ensor *In* Defense Dept. Shock, Vibration and Assoc. Environ., Pt. 3 Mar. 1964 p 45–55 refs (See N64-20235 13-01)

Three calibrators are described in detail. The descriptions include block diagrams as well as a discussion of the consideration made in arriving at each calibrator design. An analysis of the errors present in the calibrators is included. Author

N64-20241 Mitron Research and Development Corp., Waltham, Mass.

A PEAK SHOCK VELOCITY RECORDER FOR STUDYING TRANSPORTATION HAZARDS

M. Gertel *In* Defense Dept. Shock, Vibration and Assoc. Environ., Pt. 3 Mar. 1964 p 57–62 refs (See N64-20235 13-01)

This paper describes a self-contained shock recorder package capable of recording 10,000 impact shocks or operating for 30 days unattended, whichever occurs first. This and similar packages will be shipped varying distances by several routine methods to obtain data for a statistical study of shipping and handling shock conditions. Author

N64-20243 Radio Corp. of America, Princeton, N.J.

AUTOMATIC ACCELEROMETER CHECK-OUT EQUIPMENT

G. M. Hieber and B. Mangolds *In* Defense Dept. Shock, Vibration and Assoc. Environ., Pt. 3 Mar. 1964 p 69–72 (See N64-20235 13-01)

This paper describes a system for reducing instances of lost or erroneous accelerometer data. The system allows a relatively rapid means of checking 59 channels for faulty equipment or faulty setup. A charge amplifier is cycled through each input circuit to sense for changes of capacity. When no changes are sensed, a programed calibration

signal is then applied to all channels, by transformer coupling, in series with the shield of each accelerometer coaxial cable. Author

N64-20244 Ling-Temco-Vought, Inc., Anaheim, Calif. Western Div.
THE CONDENSER MICROPHONE FOR BOUNDARY LAYER NOISE MEASUREMENT
W. T. Fiala and J. J. Van Houten *In* Defense Dept. Shock, Vibration and Assoc. Environ., Pt. 3 Mar. 1964 p 73–78 refs This paper was not presented at the symp. (See N64-20235 13-01)

The condenser microphone being used for boundary-layer measurement is of stainless steel construction with mating parts designed to yield minimal change in sensitivity with temperature. The active diameter of this microphone is 0.16 in. It is designed for convenient flush mounting at an aerodynamic surface. An illustration of the microphone and a cathode follower capable of operation within the temperature range from 0° to 525° F is shown; a graph of the basic response of this microphone is given, and the frequency response at various reduced pressures is included. A summary of the following characteristics of this microphone system is also included: performance, environmental, and physical characteristics. R.T.K.

N64-20303 Army Missile Command, Huntsville, Ala. Inertial Guidance and Control Lab.
AB-3 STABILIZING GYRO DEVELOPMENT PROGRAM PLAN
J. V. Johnston 1 Apr. 1964 30 p
(RG-TR-64-1; AD-438506)

To meet the Army's need for a medium-to-high-accuracy gyro that can be used for many applications, various gyro systems were investigated. Miniaturization is required for the full-freedom gimbals because the use of existing air-bearing gyros would enlarge an outer gimbal system beyond the size of present-day configurations; increased size means increased weight, so size reduction of the stabilizing gyro is necessary. This approach also provides a large reduction in weight, which in turn can produce lighter G&C sections for extended range missiles. A size was selected that provides one-tenth the volume and one-fourth the weight of the AB-5 stabilizing gyro. Author

N64-20327 National Bureau of Standards, Boulder, Colo. Boulder Labs.
INSTRUMENTATION OF EXPERIMENTS FOR REMOTE MICROWAVE PROBING OF THE ATMOSPHERE
Ernest G. Hildner 15 May 1963 28 p refs
(NBS-7698; AD-406927)

Experiments to determine the water vapor and temperature profiles of the earth's atmosphere by observing radiofrequency thermal emission of the atmosphere consist of two receiving systems. The operating frequency of System A (lower frequency) will be somewhere in the range of 3 to 20 Gc/sec, and the operating frequency of System B (higher frequency) will be the resonant frequency of the water molecule, roughly 22.3 Gc/sec. At the System A operating frequency, the observed radio intensity is due to diatomic oxygen. The observed thermal noise at System B frequency is due to atmospheric water vapor and diatomic oxygen. The oxygen contribution to the observed thermal noise at the System A frequency can be extrapolated to yield the oxygen contribution expected at System B frequency. Subtracting the oxygen contribution from the total observed thermal noise at the System B frequency provides the contribution due to water vapor at a previously determined temperature. Knowing the temperature profile, the water vapor profile can be deduced from System B observations. Author

N64-20385 Massachusetts Inst. of Tech., Cambridge
BASIC APPLIED RESEARCH IN FLUID POWER CONTROL
Progress Report No. 8998-5, 6 [1 Feb. 1963-31 Sep. 1963]
H. H. Richardson et al Feb. 1964 127 p refs
(Contract AF 33(657)-7535)
(RTD-TDR-63-4252; AD-435774)

Technical results are presented, and progress in several phases of continuing applied research and development of the design of high-performance fluid control devices for advanced aerospace systems are described. Continued emphasis was placed on pneumatic components and systems capable of performing in wide ranges of temperature and with intense radiation. Current research dealing with a new pneumatic pulse actuation servosystem, a gas-operated accelerometer, the dispersion of transients in fluid transmission lines, compressible dampers, negative-stiffness flapper valves, and gas-lubricated bearings are also discussed. Author

N64-20395 Aeronautical Systems Div., Wright-Patterson AFB, Ohio
RADIATION PHYSICS: ITS IMPACT ON INSTRUMENTATION
Rudy C. Beavin Sep. 1963 27 p refs Presented at the ASD 1963 Sci. and Eng. Symp., Wright-Patterson AFB, Ohio, 18–19 Sep. 1963
(ASD-TDR-63-697; AD-428970)

Presented is an argument for exploiting radiation physics for the solution of problems in the instrumentation area. A brief review is given of basic physics connected with radiation. Several problems in the flight control area are stated and possible solutions presented using radiation physics concepts. Three of these problems, low altitude altimetry, high altitude altimetry, and fuel mass measurement, are examined in detail and experimental and analytical results given. A program philosophy and the establishment of an in-house experimental facility for exploitation of radiation physics are also reported. Author

N64-20437 National Bureau of Standards, Boulder, Colo. Boulder Labs.
A DC-RF SUBSTITUTION ERROR IN DUAL ELEMENT BOLOMETER MOUNTS
Glenn F. Engen 13 Aug. 1963 31 p refs
(NBS-7934)

If only the sum of the resistances of the two elements in a coaxial mount is maintained at a constant value, and if the resistance division between the two elements changes with the application of RF power, an error is introduced that is given by the equation: $\epsilon = [(1/\gamma_b) - (1/\gamma_a)]\,\Delta r$, where γ_a and γ_b are the "ohms per milliwatt" coefficients of the two bolometer elements, and Δr is the shift in resistance division. An experimental study indicates that, in the existing state-of-the-art, this error may be ignored in many applications, but is large enough to be important in others, particularly at the higher power levels. Author

N64-20464 Aerospace Corp., El Segundo, Calif. Electrical and Optical Dept.
APPLICATION OF DOPED GERMANIUM DETECTORS TO DETECTION OF SPACEBORNE TARGETS
C. L. Patterson Mar. 1964 61 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-30; TDR-269(4130-14)-1; AD-438031)

A comparison is made between measured characteristics of doped germanium detectors and an ideal background radiation noise-limited device. Although data for a variety of background conditions are not available, sufficient information to permit a crude estimate of detectivity for low background flux is available. Several potential problems, such as high detector impedance and cryogenic requirements, are discussed. In addition, spectral match between detector response and target radiation distribution is discussed. Author

N64-20482 Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
PROBABILITY DENSITY ANALYZER MODEL 160. INSTRUCTION MANUAL Summary Report
Herbert L. Fox Sep. 1963 132 p refs
(Supported by B and K Instruments, Inc.)
(Rept. 895)

This manual covers the following: (1) background on the concept of probability density; (2) the theory of measurement; (3) general theory of the PDA; (4) measurements made with the PDA; (5) the Model 160—operational procedures, technique of alignment and calibration, performance data, and specifications. Some special techniques and problems are discussed. Author

N64-20490 Hawlett-Packard Co., Palo Alto, Calif.
TIME DOMAIN REFLECTOMETRY Application Note 62
1964 20 p

A new technique for evaluating a transmission line is discussed. This technique, time domain reflectometry (TDR), isolates and identifies the character of transmission-line disturbances. Using a fast step generator and an oscilloscope in a "closed-loop radar" arrangement, TDR's echo technique shows at a glance the impedance of each segment of the line, separates junctions, locates and identifies resistive, inductive, and capacitive discontinuities, and shows if they are series or shunt. I.v.L.

N64-20493 Sierra Research Corp., Buffalo, N.Y.
HIGH-ACCURACY FREQUENCY STANDARDS IN AERIAL NAVIGATION Final Report
Roger B. Russell, Jr. and John P. Chisholm Mar. 1964 155 p
(Contract FA-WA-4222)
(TR-0373)

A study program was undertaken to determine the desirability and utility of the application of precise clocks (or frequency standards) to aircraft positioning measuring systems (or navigation systems). The study included an investigation of both atomic and crystal frequency standards with regard to their performance relative to this application. It also included the study of long-range navigation systems and their airborne equipment. Systems studied were LORAN C and various VLF systems, mainly Omega. Some effort also was put into a VHF terminal navigation concept that could be considered a long-range ILS or sectored TACAN. The concept of improved displays and of a simple analog computer for use with a rho-rho precise clocked LORAN C system was also studied. Author

N64-20498 Lockheed Missiles and Space Co., Sunnyvale, Calif.
OPTICAL IMAGE CONVERTERS Annotated Bibliography, 1961-1963
Jack B. Goldmann, comp. Jan. 1964 24 p refs
(SB-64-5; Rept. 8-13-64-1)

A literature search was made to determine the variety of techniques used in the development of the optical image converter. This annotated bibliography of 45 references emphasizes the advances and innovations for the years 1961–1963. Author

N64-20509 European Organization for Nuclear Research, Geneva (Switzerland) Accelerator Research Div.
HIGH PRECISION APPARATUS FOR DISTANCE MEASUREMENTS [APPAREIL DE HAUTE PRECISION POUR LES MESURES DE DISTANCES]
J. Gervaise 17 Mar. 1964 37 p refs In FRENCH
(CERN-64-16)

An instrument for measuring CERN distances is described. It consists of: (1) an invar filament; (2) a high-precision micrometer screw; (3) a steel knife oscillating in the ball bearing; and (4) an air-level for assuring the reproducibility of the measurements. Its novelty lies in the simultaneous use of the above four components. The instrument is simple, very light, relatively easy to handle, and has a reproducibility of ±0.01 mm. Uses include: (1) the control of parallelism of the rails of a traveling bridge (gantry); (2) the control of the position of 100 magnets of the proton synchrotron with regard to reference pillars; (3) measurements of the stability of the earth; and (4) the establishment of geodetic base lines of reference for the determination of a reseau of high-precision triangulation in space. Although the instrument is mainly for measuring horizontal distances, it can be used for measurements in a vertical sense, such as deformations in bridges. I.v.L.

N64-20530 Nuclear-Chicago Corp., Des Plaines, Ill.
DEVELOPMENT ENGINEERING OF CD V-797 CALIBRATOR Final Report
Apr. 1964 33 p
(Contract OCD-OS-62-197)

A research and development program was conducted to design and produce the CD V-797 Calibrator, which was to be used for field radiation calibration and range checking of the CD V-711 Remote Sensor Radiation Meter. Each calibrator comprised a small Cesium-137 source with an electrometer and high voltage test circuit. Two prototype models of the calibrator were constructed, and each was used to standardize three CD V-711 remote sensors. Comparisons were made with R-meter calibrations, and estimates were derived for overall accuracy and precision. This report contains laboratory test data, assembly and schematic drawings, production cost estimates, and parts lists. Author

N64-20536 California U., Berkeley Lawrence Radiation Lab.
HAZARDS CONTROL Quarterly Report No. 15, Oct.-Dec. 1963
J. R. Gaskill et al 1963 36 p refs
(Contract W-7405-ENG-48)
(UCRL-7637)

The main effort to date in the development of a material for a personnel dosimeter has been to "tailor" the thermoluminescent glow curve. The curve of LiF doped with Eu-Mg had one main peak at a very desirable temperature, with the lower temperature region containing only a small fraction of the total stored energy. It is suggested that the Mg may have a "quenching" effect on the low-temperature traps (or on the emission from them). A water loss experiment was performed at the Livermore Pool Type Reactor to assess the magnitude of such a possible accident. The loss of water shielding over the core presents only a small radiation hazard to personnel at most locations in and near the reactor

building. However, water loss directly over the reactor vessel and on a line of sight with the core could present appreciable hazard. An apparatus has been constructed for detecting small amounts of Pu in containers of dry radioactive waste material. A water monitor and alarm circuit was designed to detect rupture of high-level radioactive slugs (heavy element activity plus fission products) stored under a water shield. Also discussed are the evaluation of the comparative iodine adsorption capacity of molecular sieve 5A and activated charcoal, protective clothing for emergency personnel, and one-man operation of the pumper snorkel. I.v.L.

N64-20603* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

AN INSTRUMENT FOR THE MEASUREMENT OF INTERPLANETARY SOLAR PLASMA

Conrad Josias and James Lawrence, Jr. 1 May 1964 69 p refs

(NASA Contract NAS7-100)

(NASA-CR-56038; JPL-TR-32-492) OTS: $6.60 ph

An important scientific result of the interplanetary flight of the Mariner II spacecraft to Venus was the collection of extensive detailed data indicating the presence of a constantly flowing "solar wind." The Mariner II solar plasma instrument and its predecessor, which flew on Rangers I and II, are described. Special emphasis is given to the discussion of a wide-range electrometer system stabilized by a dynamic capacitor. The instrument measures charged-particle energy spectra with a sensor consisting of a pair of concentric curved electrostatic deflection plates terminated by an isolated Faraday collector cup. The collection rate of charged particles is measured with an electrometer whose wide dynamic current range is provided by a logarithmic compressor composed of one or two subminiature thermionic diodes operated in the retarded field region. The electrostatic field is controlled by a programed high-voltage sweep amplifier that provides the deflection plates with voltages of equal magnitude but opposite polarity. Author

N64-20615 Japan Broadcasting Corp., Tokyo Acoustics and Audio Frequency Research Div.

DIRECTIONAL MICROPHONES: ANALYSIS AND APPLICATION Technical Monograph No. 2

Heitaro Nakajima and Takeo Yamamoto Jan. 1964 38 p refs

The analyses and design of the phase-shift directional microphone consisting of two acoustic terminals and one electromechanical transducer are discussed. To obtain a desired frequency response and directivity, the relations between element values in the equivalent circuit of the vibrating systems are analyzed; various problems are studied arising when the analytical results are applied to realization of the mechanical and acoustic circuit. Using the above analyses, the unidirectional condenser microphone, bidirectional ribbon microphone, varidirectional ribbon microphone, and uniaxial unidirectional ribbon microphone are designed; the performance characteristics of these microphones are presented. Author

N64-20625 Canadian Armament Research and Development Establishment, Valcartier

THE INSTRUMENTATION SYSTEM OF PROPULSION TEST VEHICLES CC II A 54 AND CC II A 55

R. Lafrance and L. Gosselin Mar. 1963 38 p

(CARDE-TN-1518/63)

The specifications and the location of the transducers, the telemetry systems, and the power sources are given. The attitude transducers are briefly discussed. Self-explanatory photographs and the calibration data are included. Author

N64-20627 Flying Personnel Research Committee (Gt. Brit.)

ALTIMETER DISPLAY RESEARCH. SUMMARY OF THE EVALUATION PROGRAMME

J. M. Rolfe (R.A.F. Inst. of Aviation Med.) Nov. 1963 17 p refs

(FPRC-1215)

Research was conducted to determine the best way to display altitude information through literature search, compilation of human engineering checklist, user opinion survey, laboratory tests of legibility (static trial), laboratory tests of tracking performance (dynamic trial), flight simulator trials, and flight trials. It was concluded that both forms of the counterpointer display are superior to conventional multipointer displays. When leveling from a descent, there is a tendency for pilots to level out 950 ft too high. This error is the only one that is associated with counterpointer displays and rapidly disappears with experience. Future research into altitude display should consider the possibilities of combining altitude and vertical speed information, and the use of all digital indication. Advantages and disadvantages of the various methods used in each phase are also presented. Author

N64-20639* Columbia U., New York, N.Y.

A FIELD ION MICROSCOPE FACILITY FOR SOLID STATE AND SURFACE STUDIES

Eugene S. Machlin 31 Mar. 1964 4 p

(NASA Grant NsG-294-63)

(NASA CR-56015) OTS: $1.10 ph

Two major experimental results have emerged from the field ion microscopy studies. One concerns the precipitates in carbon-doped tungsten and the other concerns the nature of radiation damage in irradiated platinum. Coherent precipitates were observed in tungsten charged with carbon quenched at approximately 1,800° C. These precipitates lie along (100) planes and vary in thickness from about one atomic layer to four and five atomic layers as determined by field evaporation experiments. The average length of the precipitates was not determinable. Both collections of interstitials and vacancies were detected in room-temperature neutron-irradiated platinum. From the observed shapes, the interstitials are thought to be in the form of tetrahedra, whereas the vacancies are in the form of plates. A radioactive analysis revealed no major impurities that could account for these results. In addition, stacking faults were observed. I.v.L.

N64-20642* Geophysics Corp. of America, Bedford, Mass.

SOLIDS MASS SPECTROMETER Quarterly Technical Progress Report, No. 2, 4 Feb.-3 May 1964

[1964] 24 p

(NASA Contract NASw-839)

(NASA CR-56039)

Major effort was directed toward producing a beam of argon ions that is essentially free of any contaminants. The importance of this task for any trace analysis comes from the fact that some of the contaminants of the primary beam are continuously deposited on the target and sputtered together with the target material. This task was accomplished by the replacement of the oil-cooled duoplasmatron by an air-cooled version of otherwise very similar construction and by the use of a tungsten wire containing 2% thorium as a replacement for the original filament. Also, in order to eliminate the strong iron–copper peaks, the baffle electrode was lined with a thin-wall tantalum inset, and the anode was modified, so that all the walls in contact with or close to the arc are now of tantalum. After the primary beam was essentially free of contaminants, secondary ion spectra were taken of spectrographically pure samples and of certified standards obtained from NBS of silver, copper, cadmium, and iron #465. Results indicated

that most of the observed contaminants were in the samples and not caused by a general instrumental background. I.v.L.

N64-20670 Hanford Atomic Products Operation, Richland, Wash. Separations Chemistry Lab.
AUTOMATIC SAMPLE CHANGER FOR GAMMA SCINTILLATION WELL DETECTOR
W. H. Zimmer Feb. 1964 20 p
(Contract AT(45-1)-1350)
(HW-80798)

An automatic sample changer was built that accepts samples from a gravity fed magazine and delivers them to a well scintillation detector for analysis. After analysis, the samples are removed from the detector and delivered to waste. Both the sample magazine and the waste container are far removed from the detector to avoid radiation interference. All sample transfers are pneumatic and are sequenced and controlled by a changer mechanism. Author

N64-20708* Engineering-Physics Co., Rockville, Md.
DEVELOPMENT OF AN ELECTROMAGNETIC INDUCTION FLOWMETER FOR CRYOGENIC FLUIDS Final Report
Vincent Cushing, Dean Reily, and George Edmunds 15 May 1964 114 p refs
(NASA Contract NASw-381; EPCO Proj. 105)
(NASA CR-56128) OTS: $9.60 ph

An electromagnetic (EM) induction flowmeter for use with liquid hydrogen (LH_2) is described. This flowmeter has reached a stage of development where experimental results are in complete agreement with theory. New plumbing practice problems, peculiar to the use of LH_2 with the induction flowmeter's dielectric transducer tube, have been solved; it has been established that a flow signal is obtainable even with the stringent electrical characteristics of liquid hydrogen. The device is operable when temperature equilibrium is reached in the transducer tube. The theory of operation of the EM flowmeter, its electronic and mechanical configuration, an error analysis that describes the accuracy attainable in terms of the various component tolerances, the test and operating procedures, and the specific details of the mechanical and electrical design are discussed. R.T.K.

N64-20727* Advanced Technology Labs., Mountain View, Calif.
EVALUATION OF HEAT-FLUX METERS. PHASE 2 – EXPERIMENTAL INVESTIGATION Final Report, Feb. 1962-Oct. 1962
D. R. Hornbaker and W. H. Giedt Huntsville, Ala., NASA. Marshall Space Flight Center, 31 Oct. 1962 74 p refs
(NASA Contract NAS8-1571)
(NASA CR-56137; ATL-D-922) OTS: $7.60 ph

An experimental program to evaluate the accuracy and applicability of slug-type heat-flux meters was conducted. The aim of the program was to substantiate an analytical study, and to further determine the major design parameters involved in the use of slug-type heat-flux meters. An additional objective of the program was to establish a practical and versatile laboratory procedure that would provide convective and radiant heating separately and concurrently for laboratory calibration of heat-flux meters. An apparatus having this capability was designed and constructed. It consists of a 30-tip oxyacetylene torch and an electrically heated graphite-block radiator with a 6-in. × 6-in. heating surface. Standardization of heat flux from the apparatus was established by means of precise temperature measurements on a special thin plate of stainless steel for which the heat capacity was precisely known. Two meter designs were tested. Author

N64-20739* Santa Barbara Research Center, Goleta, Calif.
MARINER "C" EXIT OPTICS ASSEMBLY AND COOLING SYSTEM Final Report
J. J. Long 6 Apr. 1964 12 p
(NASA Contract NAS7-100; JPL-950548)
(NASA CR-56173) OTS: $1.60 ph

Progress is reported in the development of the PbSe immersed detector, the refrigeration assembly, and the optical design for the PbSe detector. Spectral curves of the optical elements (dichroic beam splitter, silicon lens of the PbSe detector, and micron interference filter) are included. R.T.K.

16 LIFE SCIENCES

Includes biology; exobiology; physiology; medicine; life support systems; radiation effects on biological systems; and space sickness. *For related information see*: 14 Human Behavior; and 28 Space Radiation.

N64-20012 Joint Publications Research Service, Washington, D.C.
CYBERNETIC CONTROL OF THE REVERSIBLE HYPOTHERMY PROCESS
Ye. V. Maystrakh, I. V. Yeremenko, G. I. Il'yutkin, and V. A. Konstantinov 7 May 1964 10 p Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 151, no. 3, 1963 p 714-717
(JPRS-24504; OTS-64-31198)

A reversible hypothermy automatic apparatus is discussed. The first step in designing this apparatus consisted of selecting the system or technical-data sensing units. In later steps, the following were developed: (1) a logic circuit that automatically processes the indications of sensing devices in a manner that insures preference of the technical automatic device in the "competition" between the biological and technical automatic devices during the given time of hypothermy, and insures preference of the biological automatic devices during all other periods of time; (2) a programing circuit that enables the duration and the schedule of the hypothermy process to be fixed and regulated; (3) an operating system that enables the administration of the components of the gas mixture through the mask, and the administration of the cooling or heating liquids to the apparatus that cools the animals. The main elements of the logic circuits in both the contour of temperature regulation and gas-mixture regulation are four-input decoders with subsequent assembly circuits. The apparatus discussed has been operated with sufficient reliability. I.v.L.

N64-20020* Library of Congress, Washington, D.C. Science and Tech. Div.
ABSTRACTS OF CURRENT LITERATURE: AEROSPACE MEDICINE AND BIOLOGY
Arnold J. Jacobius Repr. from Aerospace Med., v. 35, no. 4, Apr. 1964 p 389-400 refs
(Supported by NASA)

Categories covered by the abstracts presented include: (1) biology; (2) general physiology; (3) neurophysiology and sensory physiology; (4) psychology and psychiatry; (5) environmental physiology and psychology; (6) aerospace personnel (the effect of age on performance and on various physiological factors); (7) medical problems and pharmacology; (8) toxicology; (9) safety, survival, and rescue; and (10) man–machine integration and life-support systems. I.v.L.

N64-20181 Chicago U., Ill. USAF Radiation Lab.
[RESEARCH ON CERTAIN BIOLOGICAL AND MEDICAL ASPECTS OF ATOMIC ENERGY] Quarterly Progress Report No. 51
Kenneth D. Du Bois 15 Apr. 1964 131 p refs
(Contract AF 41(609)-1693)
(AD-438895)

Research activities in the following areas are discussed: (1) toxicity and mechanism of action of 2-mercaptoethylamine; (2) influence of X-irradiation on the development of a thiophosphate-oxidizing enzyme system in the livers of rats; (3) influence of steroids and other factors on the development of radiation sensitive detoxification systems; (4) effects of 2-imino-thiazolidine-4-carboxylic acid on the radioprotective activity of various chemical agents; (5) influence of various chemical compounds on radiation lethality in mice; (6) dose-mortality relationships for several radioprotective agents; (7) role of sodium nitrite in radioprotection in mice; (8) chemical radioprotection against absorber-moderated protons; and (9) effect of the addition of 2-mercaptoethylamine or para-aminopropiophenone to the diets of chronically irradiated mice and the production of methemoglobin by feeding a diet containing para-aminopropiophenone. P.V.E.

N64-20194* National Aeronautics and Space Administration, Washington, D.C.
OPTIMUM CONDITIONS FOR RECORDING ELECTROPLETHYSMOGRAMS OF PARTS AND ORGANS OF THE HUMAN BODY [OPTIMAL'NYYE USLOVIYA REGISTRATSII ELEKTROPLETIZMOGRAMMY UCHASTKOV TELA I ORGANOV CHELOVEKA]
Yu. Ye. Moskalenko May 1964 11 p refs Transl. into ENGLISH from Fiziol. Zh. SSSR (Moscow), v. 48, no. 2, 1962 p 214–218
(NASA TT F-203) OTS: $0.50

The biophysical phenomena that arise in the electric parameters of parts of the human body are examined to determine the optimum conditions for recording electroplethysmograms. Frequencies of 100 to 150 kc were found to be best for recording purposes. Author

N64-20229 Joint Publications Research Service, Washington, D.C.
STUDIES IN AUDITORY MEDICAL RESEARCH
8 May 1964 17 p refs Transl. into ENGLISH of 3 articles from Vestn. Otorinolaringol. (Moscow), no. 1, Jan.–Feb. 1964 p 3–7, 76–78
(JPRS-24519; OTS-64-31227) OTS: $0.50

CONTENTS:

1. THE FUNCTION OF THE AUDITORY ANALYSOR IN THE LIGHT OF MODERN BIOLOGY V. I. Voyachek p 1–8 refs

2. NEW ACCESSORY ILLUMINATOR FOR MICROOPERATIONS ON THE EAR B. S. Preobrazhenskiy, Yu. A. Tsepelev, and V. I. Remizov p 9–12

3. INSTRUMENT FOR BOUGIENAGE OF EUSTACHIAN TUBES DURING DIRECT ADENOTOMY A. G. Amirov p 13–14

N64-20232 Joint Publications Research Service, Washington, D.C.
THE NATURE OF ULTRAVIOLET LUMINESCENCE OF CELLS
S. V. Konev et al 14 May 1964 21 p refs Transl. into ENGLISH from Biofizika (Moscow), vol. 8, no. 4, 1963 p 433–440

A study was made of the luminescence spectra at room and low temperatures, after integral and monochromatic excitation, as well as of luminescence excitation spectra and luminescence polarization spectra (with respect to absorption), of the isolated fractions of mitochondria and nuclei of white rat liver cells. The spectra indicated that the luminescence of mitochondria and nuclei of these cells, excited with spectral region of 250 to 300mμ, is due exclusively to proteins (tryptophan). Author

N64-20233 Joint Publications Research Service, Washington, D.C.
NUCLEAR MEMBRANE POTENTIAL OF THE NERVE CELL
B. W. Veprintsev and D. A. Sakharov 14 May 1964 6 p refs Transl. into ENGLISH from Biofizika (Moscow), vol. 8, no. 4, 1963 p 526
(JPRS-24607; OTS-64-31261) OTS: $0.50

The large nerve cells of the snail, *Lymnaea stagnalis*, were investigated. The size of the nucleus amounted to about half of the external diameter of the cell. Upon insertion of a microelectrode into a single cell the resting potential (RP) in many cases reached its maximum value by leaps rather than immediately after the piercing of the nerve cell membrane. On the penetration of the electrode into the cell the value of RP either remained constant until the reemergence of the microelectrode tip on the other side of the cell, or changed with a leap up to −70 mv. The maximum value of RP obtained was −70 mv. During the passage of the microelectrode through the cytoplasm and the nucleoplasm, the RP did not change. R.T.K.

N64-20373 Naval School of Aviation Medicine, Pensacola, Fla. Naval Aviation Medical Center
THE PROTECTIVE EFFECT OF XYLOCAINE ON THE TOLERANCE OF VIBRATED RATS TO EXPLOSIVE DECOMPRESSION Research Report No. 6
Donald E. Furry 1 Nov. 1963 8 p refs
(AD-432880)

Tolerance of restrained Sprague–Dawley male rats to explosive decompression from sea level to 40,000 ft in approximately 0.01 sec is markedly reduced when the animals are previously exposed to 30 min of whole body mechanical vibration of 25 cps frequency and 0.25-in. displacement (peak to peak). The administration of an intraperitoneal injection of 1.0 ml of 2 percent Xylocaine, however, effectively increases this tolerance. Major pathologic findings were confined to the lungs and consisted of gross and histological evidence of pulmonary hemorrhage, edema, and atelectasis. Author

N64-20380 School of Aerospace Medicine, Brooks AFB, Tex.
THE EEG IN AEROSPACE MEDICINE. THE ELECTROENCEPHALOGRAM IN AIRCREW AND ASTRONAUT SELECTION
Donald R. Bennett and Roger C. Duvoisin Dec. 1963 23 p refs (Rept 12-63; AD-433104)

Attempts to correlate flying aptitude with the electroencephalogram have so far been unsuccessful. Although difficulties have arisen in establishing criteria for rejection of apparently normal individuals, the EEG has been shown to have a definite, if limited, value in screening aircrewmen for epileptics. Those with specific paroxysmal patterns should not be accepted for flying duties whether or not a history of previous episodes of loss of consciousness or seizures can be obtained. Hyperventilation and photic stimulation are useful activating procedures, but convulsive agents such as Metrazol have not proved helpful in identifying epileptics. It is not justifiable to reject a candidate on the basis of nonspecific EEG abnormalities

when his neurologic history and examination are normal. In-flight EEG recordings are as yet experimental, and their interpretation requires simultaneous recording of other physiologic variables, including alveolar CO_2 and blood pressure. Author

N64-20445 Stanford U., Calif.
THE DISTRIBUTION OF BLOOD FLOW IN HUMAN SKIN Progress Report, Jul. 1, 1960–Jun. 30, 1962
J. M. Crismon 16 May 1963 20 p refs
(Grant DA-MEDDH-60-9)
(AD-405777)

Methods were devised for simultaneous measurement of total forearm blood flow and clearance of I-131 from the skin after intradermal injection or iontophoresis of the isotope. These methods were used to study the effects of reactive hyperemia, general body heating and the action of topically applied rubifacient substances on total forearm blood flow and upon clearance of I-131 from the skin. The increased blood flow of reactive hyperemia was reflected during the early period of isotope clearance, but factors other than blood flow dominated the clearance of isotope from skin 25 to 40 minutes later. N-hexyl nicotinate, an active rubifacient applied to the skin by inunction of a 2% cream increases both total blood flow and flow through the superficial capillaries of the skin. The relative increases of skin blood flow and clearance of isotope were consistent with an increase of total skin blood flow larger than the effective or "nutrient" blood flow through the region sampled by the clearance. The large increase of blood flow through the skin produced by general body heating is poorly reflected by increased clearance of radioactive iodide into the skin. A method for graphical analysis of semilog plots of complex regressions with more than one exponent was devised. Author

N64-20450 Naval Air Development Center, Johnsville, Pa. Aviation Medical Acceleration Lab.
ELECTROENCEPHALOGRAPHIC CHANGES IN HUMAN SUBJECTS DURING BLACKOUT PRODUCED BY POSITIVE ACCELERATION Report No. 12
Russell D. Squires, R. E. Jensen, W. C. Sipple, and J. J. Gordon 6 Apr. 1964 22 p refs
(NADC-ML-6402; AD-438485)

Each of 13 human subjects was subjected alternately to a set of peak accelerations of 6 g and 7 g on two separate occasions. One channel of EEG was recorded by placing two active electrodes, one on the right and one on the left side of the calvaria, approximately 2 cms above and lateral to the occipital protuberance. Analysis of the taped EEG signals was accomplished by a 14-channel continuous frequency analyzer using bandpass filters. The voltage output of each bandpass filter was rectified and passed through a smoothing filter to obtain a direct current voltage proportional to the amplitude of the frequency band passed by each filter. An increase in beta frequencies, 16 to 36 cps, occurred showing the same general amplitude pattern as the acceleration profile. The lower beta frequencies, 16 to 19 cps, had a tendency to level out or to decrease during each blackout coincident with an increase in the lower frequency components. The alpha frequencies, 8 to 13 cps, often appeared during grayout and blackout, but may disappear during very deep blackout when bursts of high-amplitude, low-frequency components appear. The best index of the level of consciousness appears to be the inverse relationship between the depth of blackout and the amplitude of EEG frequencies in the range of 5 cps. The 5- to 7-cps frequency band is associated with cerebral hypoxia, which occurs during positive acceleration. Author

N64-20477 Atomic Energy Commission, Washington, D.C. Div. of Technical Information
THE TRANSPORTATION OF RADIOACTIVE MATERIALS
N. I. Leshchinskii Apr. 1964 247 p refs Transl. into ENGLISH of the book "Transportirovanie Radioaktivnykh Veshchestv" Moscow, Gosatomizdat., 1962 195 p
(AEC-TR-6315) OTS: $3.00

There are four chapters as follows: (1) "The Effect of Radioactive Materials on the Human Organism"; (2) "Rules for the Transportation of Radioactive Materials in the Soviet Union"; (3) "International Rules for Shipment of Radioactive Materials"; and (4) "A Comparison of the Soviet and International Rules for Transportation of Radioactive Materials." A.W.

N64-20483 Joint Publications Research Service, Washington, D.C.
STRAIN ON THE VISUAL ANALYZER
A. A. Zubkov and G. G. Rud' 13 May 1964 7 p Transl. into ENGLISH from Zdravookhr. (Moscow), v. 6, no. 2, 1963 p 38-41
(JPRS-24592; OTS-64-31256) OTS: $0.50

The visual analyzer was investigated by studying a form of work that required the use of a magnifying glass making it possible to reliably determine the alternation of the right and left eye in controlling the operation. The critical flicker frequency is used as an index of eye fatigue. It was demonstrated that the alternate use of both eyes is a definite advantage when compared with the continuous use of one eye. This is shown, first, by the significantly higher critical flicker frequency of both eyes (measured together and separately) at the beginning of the day and, second, by the slight reduction toward the end of the day. From the data, it is concluded that alternating the function of cortical representations of the right and left eyes increases the functional ability of the cortical end of the visual analyzer as a whole and increases its resistance to fatigue. R.T.K.

N64-20485 New Jersey State Dept. of Health, West Orange Radium Research Project
SURVIVAL EXPERIENCE OF THE RADIUM CASES
Abraham H. Libove and Lester A. Barrer Washington, AEC, Div. of Tech. Inform., Mar. 1963 46 p refs
(Contract AT(30-1)-2181)
(NYO-2762) OTS: $1.00

Described are the results of attempting to establish a procedure for comparing actual survival rates with the expected survival rates of a group of individuals under investigation. The procedure used was developed for comparing survival of individuals exposed to radium with the expected rates computed from the general life tables for New Jersey men and women. This method also serves to describe some of the characteristics of the exposed group. From a universe of 921 persons, known to be former employees of the radium industry, a nonrandom sample of 289 was selected. The basis of selection was data concerning each individual including sex, date of birth, and date of death or year last known to be alive, as well as data regarding exposure to radium—age at initial exposure, year of first exposure, and place, type, length of time, and continuity of exposure. Inferences drawn from this trial should not be considered applicable to the entire population of known radium cases, since no valid statistical relationship was established between the sample selected for trial and the total data available. Author

N64-20517 Lockheed Missiles and Space Co., Sunnyvale, Calif.
RADIATION EFFECTS UPON EXPERIMENTAL ANIMALS, MAN, AND PLANTS, VOLUME I, A-L Annotated Bibliography, 1961-1962

Jack B. Goldmann, comp. Jan. 1963 440 p refs
(SB-62-60; Rept. 5-10-62-54)

The scope of this annotated bibliography is comprehensive, but not exhaustive. The 2,203 references reflect the volume of literature available in English and foreign languages (June 1961–June 1962) in the sequential order indicated by the title. Lethal doses, genetic effects, illness, and decrease of life span are some of the subject areas identified with the experimental animals, man, and plants. An author index is included. Author

N64-20588* Itek Corp., Palo Alto, Calif.
A STUDY OF AUSCULTATORY BLOOD PRESSURES IN SIMULATED ARTERIES
Alvin H. Sacks, K. R. Raman, and Jack A. Burnell [1963] 29 p Presented at the 4th Intern. Congr. on Rheology, Brown U., 26–30 Aug. 1963
(NASA Contract NAS2-1137)
(NASA CR-56024) OTS: $2.60 ph

After preliminary analysis of the pulsatile viscous flow in flexible tubes, a large-scale pulsating flow system was constructed. Various simulated arteries of 1-inch inside diameter were tested under varying conditions of pulse rate, pressure level, and pulse pressure, using first, various mixtures of water and glycerol and, finally, whole steer blood as the fluid. The oscillatory intra-arterial pressures were recorded by pressure transducers that were attached to both static and total pressure probes in the flow itself; these were compared with measurements of the systolic and diastolic pressures obtained by the clinical auscultatory technique, using a stethoscope and a specially designed pressure chamber. In addition, simultaneous measurements were made of arterial-wall displacements and the velocity of the pulse wave along the tube. The simulated system exhibits many of the qualitative features of a living human subject, and the entire spectrum of characteristic Korotkoff sounds is reproduced in the artery. Test results are presented. R.T.K.

N64-20636 Oak Ridge National Lab., Tenn.
AN AUTORADIOGRAPHIC AND HISTOLOGIC STUDY OF SPLEEN WHITE PULP GERMINAL CENTERS DURING EARLY INTERVALS OF THE PRIMARY IMMUNE RESPONSE
M. G. Hanna, Jr. May 1964 109 p refs
(Contract W-7405-ENG-26)
(ORNL-3595)

This study is concerned with the quantitative and histologic aspects of germinal center dissociation and the migration and fate of germinal center cells in the spleen of normal and antigenically stimulated animals during the primary immune response. Studies were made on the spleen white pulp since it is the only lymphatic tissue receiving a large direct exposure to the antigen after intravenous injection, thus permitting a synchronized cellular response. Autoradiographic labeling techniques were used and were predicated on the uptake of tritriated (H^3–) thymidine as an index of DNA synthesis. Investigations were also made of changes of germinal center volume during the primary immune response with concurrent measurements of cellular changes in the peripheral blood. The fate of germinal center cells was interpreted from autoradiographic preparations of spleen imprints. R.T.K.

N64-20666 Flying Personnel Research Committee (Gt. Brit.)
MODIFICATION TO FACEPIECE OF P AND Q TYPE OXYGEN MASKS
J. E. Gabb (RAF Inst. of Aviation Med.) London, Air Min., Jan. 1963 5 p
(FPRC/MEMO-194)

Deficiencies in the stability of the P and Q oxygen masks make it unsatisfactory on certain faces in routine flight, and generally liable to be displaced during escape. Prototype improved masks were made by dipping methods, without changes to the facepiece mould. Tests have shown these facepieces improve the stability of the mask under normal flight and airblast conditions, and make the satisfactory fitting of some aircrew easier. The masks are preferred by those aircrew who have used them. It is recommended that a number should be made by more precise methods for further evaluation in the laboratory and in flight. Author

N64-20672 California U., Los Angeles School of Medicine
LUNG PHOTOSCANS WITH MACROAGGREGATES OF HUMAN SERUM RADIOALBUMIN (EXPERIMENTAL BASIS AND INITIAL CLINICAL TRIALS)
G. V. Taplin, D. E. Johnson, E. K. Dore, and H. S. Kaplan Apr. 1964 47 p refs
(Contract AT(04-1)-GEN-12)
(UCLA-12-521)

Human lungs were not visualized by photoscanning until recently, for lack of a metabolizable, particulate test material, safe to inject intravenously. A method for preparing such an agent, namely 5-25μ macro-radioalbumin aggregates (MRAA) is described. Experimental evidence in animals insures a tremendous factor of safety (~1000 fold) for injecting the minute quantities needed for scanning. Experience from scanning more than 100 patients has verified the safety and revealed the diagnostic value of the procedure. It has the unique capacity to detect regional pulmonary ischemia caused by emboli and other diseases obstructing pulmonary arterial blood flow before signs of these lesions are recognizable in routine chest X-ray films. Author

N64-20679* Thompson Ramo Wooldridge, Inc., Cleveland, Ohio Electromechanical Div.
CO_2 REDUCTION UNIT DESIGNED FOR CONTINUOUS ZERO GRAVITY OPERATION Final Technical Report
A. D. Babinsky 18 Apr. 1964 69 p refs
(Contract NASw-650)
(NASA CR-54060; ER-5907) OTS: $6.60 ph

A carbon dioxide reduction unit was designed, fabricated, and tested. Carbon dioxide was reduced by hydrogen to carbon and water using flat iron plates as the catalyst. Carbon and water were continuously removed from the reaction gases. Product water was electrolyzed to oxygen and hydrogen. All components were designed for operation in a zero-gravity environment. Tests on the one half-man capacity unit were carried out at a system pressure of 2 psig. Steady reaction rates up to 900 cc/min of reaction gases were obtained at a reactor temperature of 1,200° F. Carbon was successfully removed from the reactor during operation of the system. Total accumulated test time was 40 days of operation with one continuous run of 25-days duration. Author

N64-20682* Esso Research and Engineering Co., Linden, N.J.
DEVELOPMENT OF HYDROCARBON ANALYSES AS A MEANS OF DETECTING LIFE IN SPACE Quarterly Report
W. G. Meinschein 1 Oct. 1963 21 p refs
(NASA Contract NASw-508)
(NASA CR-52217) OTS: $2.60 ph

Data have been collected which permit a testing of the hypotheses that the biochemically and chemically least active biological molecules may accumulate unaltered in the elimination products of living things and, in turn, in terrestrial sediments. The concentrations of alkanes in the benzene extracts

of cow manure, bat guano, and terrestrial sediments are comparable. These concentration exceed by more than two orders of magnitude the concentrations of alkanes in the benzene extracts of plants, animals, and a food, butter. Mass spectrometric analyses indicate that alkanes from living things, biological elimination products, and terrestrial sediments are composed of the same types of compounds. Optical activities of hydrocarbons in a crude oil obtained from a 1.1-billion-year-old sediment have been found to be of the same sign and magnitude as are the optical activities of some relatively young oils. Author

N64-20696 Rochester U., N.Y.
ON ADDITION OF MODES OF RADIATION INJURY IN PRODUCING LETHALITY IN DOGS AND RODENTS
Henry A. Blair 28 May 1964 33 p refs
(Contract W-7401-ENG-49)
(UR-654)

It is deduced from mouse and rat data on lethal dose protracted in the one-day range that about two-thirds of the body has a recovery half-time of a few days, whereas the remainder has a recovery half-time of a few hours. The slower division presumably includes the hematologic and the faster division the intestinal modes of injury. The injuries are completely additive in producing lethality as are partial body injuries produced by partial body exposures. It is deduced from data on mixed gamma and neutron exposures that injuries from these radiations add completely in mice. Partial body injuries in the dog are not directly additive. This occurs because the lethal threshold is inversely proportional to the volume in which the injury is contained. For this reason a given amount of injury is more lethal when distributed within the whole body than within a part and, consequently, partial body lethal doses are much higher relative to whole body lethal dose in dogs than in rodents. Author

N64-20705* Stanford Research Inst., Menlo Park, Calif.
STUDIES ON THE HILL REACTION ACTIVITY OF SOLUBLE CHLOROPLAST EXTRACTS Quarterly Progress Report No. 4, 1 Dec. 1963-29 Feb. 1964
Lloyd K. Moss, Janice E. B. Coomber, and Luman F. Ney 20 Apr. 1964 8 p
(NASA Contract NASr-49(11); SRI Proj. BU-4435)
(NASA CR-56130) OTS: $1.10 ph

The effect of dimethylsulfoxide (DMSO) and caffeine on the Hill reaction activity of chloroplast preparation was investigated. Results indicate that: (1) DMSO may become a useful solubilizing agent for proteins without causing marked changes in the biological properties of the proteins. Within experimental error, the Hill reaction activity of chloroplast solutions containing it was unchanged or slightly enhanced. (2) A 1%-caffeine content is not considered as a photosynthetic inhibitor, although there was a decrease in the Hill reaction activity of both whole chloroplasts and fragments. Also, operating conditions for high-voltage preparative electrophoresis on the carrier-free instrument, the Elphor FF, are described. In contrast to curtain electrophoresis, chloroplast preparations can be studied easily on a preparative scale and under high-power conditions. I.v.L.

N64-20715 Rochester U., N.Y. Radiology and Biophysics Div.
THE RETENTION OF STRONTIUM-90 IN THE RATS AS INFLUENCED BY DOSE, AGE AND ADMINISTRATION ROUTE
L. W. Tuttle, R. C. Baxter, B. J. Hopkins, and G. W. Casarett 18 May 1964 27 p refs
(Contract W-7401-ENG-49)
(UR-642)

The fractional retention of strontium-90 was measured in a total of 460 rats following a series of doses, 71 to 789μc administered either orally, intravenously, or intraperitoneally to animals that ranged in age from 40 to 470 days. Fractional retention was independent of the total dose within the range of 71 to 142μc in rats that were 6 weeks old, and 252 to 789μc in rats that were 124 days old. The fraction of the total dose retained at a given time after ingestion of Sr^{90} decreased as the age of the animal increased between the ages 40 and 346 days, but there was no further decrease for treatment after 1 year of age. The value of the slope of the line representing retention vs. time in log-log plots of the data increased with age to 1 year of age beyond which there was no further increase. Fractional retention was 5 to 6 times greater at day 15 post-treatment in animals of uniform age given intravenous or intraperitoneal injections compared with those given the isotope orally. The slope values of the retention curves were similar regardless of administration route for the portion of the curve between the 10th day after the end of the dosage regimen and the terminal observation day. Author

N64-20729* Naval School of Aviation Medicine, Pensacola, Fla.
VESTIBULAR MECHANISMS AND VISION
Earl F. Miller, II and Ashton Graybiel 1963 39 p refs Presented at the Armed Forces-NRC Vision Comm. Session on Recent Advances in the Study of Physiol. Reflex and Mech. in Vision, Washington, D.C., 9 May 1963
(NASA Order R-47)
(NASA CR-56080) OTS: $3.60 ph

The results of some investigations dealing with the vestibular and visual systems under the influence of unusual gravitational-inertial force environments (GIFE) are summarized. Among the topics discussed are: (1) otolith organs and vision, (2) egocentric visual localization, (3) semicircular canals and vision, and (4) vestibular organ interaction and vision. R.T.K.

N64-20731* Naval School of Aviation Medicine, Pensacola, Fla.
HUMAN REACTIONS TO SLOW ROTATIONAL MOVEMENTS
Ashton Graybiel 1963 17 p refs Presented at the SHAPE Meeting, Paris, 27-29 May 1963
(NASA Order R-47)
(NASA CR-53988) OTS: $1.60 ph

Human subjects exposed to Coriolis rotation in a slow rotation room had the symptoms of canal sickness (vestibular sickness) varying greatly in severity, ranging from mild malaise to prostration. The unique symptom was the Coriolis illusion. The cardinal symptoms are nausea, increased salivation, and drowsiness, and the cardinal signs are nystagmus, pallor, cold sweating, and vomiting. The relation between stimulus and response reveals the phenomena of temporal summation, the perseveration of symptoms after cessation of stimulation, and adaptation. Symptoms do not appear in persons who have lost the function of the canals and are negligible in those with partial loss of function. Preventive measures and drug therapy can aid in minimizing the symptomatology. R.T.K.

17 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and materials fabrication, handling and inspection. *For related information see*: 06 Auxiliary Systems.

N64-20013 Joint Publications Research Service, Washington, D.C.
ELECTROSLAG BUILD-UP OF CERTAIN FORMS OF FORGING DIES
B. V. Danilchenko and V. P. Subbotovskiy 8 May 1964 10 p refs Transl. into ENGLISH from Avtomat. Svarka (Kiev) no. 1, 1964 p 71–74
(JPRS-24523; OTS-64-31231)

A method of electroslag buildup for restoring drop forging dies is described. The matrix of the die heated in an electric furnace to 660° C is transported along the buildup unit, and its engraving is placed in a water-cooled copper chill mold, copying the shape of the die figure. The slag bath is introduced by an unmelted copper electrode. After the introduction of the slag bath, the welding current is turned off; the unmelted electrode is rejected; and the melting electrode is lowered into the bath under the action of gravity. The welding current is turned on. After the electroslag treatment is completed, the fused die is placed into the furnace at 600° C for 1 to 1.5 hours, after which the die cools along with the furnace. The heat treatment of the fused die includes annealing, and, after engraving, the die is then tempered and annealed. I.v.L.

N64-20015 Joint Publications Research Service, Washington, D.C.
ELECTROSLAG WELDING
N. I. Kakhovskiy, Yu. N. Gotal'skiy, V. E. Paton, and A. A. Trushchenko 12 May 1964 91 p Transl. into ENGLISH of chapter 5 of the book "Tekhnologiya Mekhanizirovannoy dugovoy i elektroshlakovoy svarki", Moscow, 1963 p 244–314
(JPRS-24559; OTS-64-31244) OTS: $2.25

This report discusses the following topics: (1) the nature of electroslag welding and its merits; (2) the variety of electroslag welding and the areas of possible use; (3) fluxes and methods of alloying the metal of the seam for electroslag welding; (4) the process of electroslag welding and initial data for selecting the optimum value of its constituents; (5) the preparation of edges and the joining of joints by the electroslag-welding process; (6) the technology of electroslag welding; (7) the electroslag welding of carbon steels; (8) the electroslag welding of alloyed steels; and (9) the electroslag welding of cast iron and other metals. I.v.L.

N64-20037 General Dynamics/Fort Worth, Tex.
MATERIALS – LUBRICATING OIL – GTO-915 – IRRADIATION UNDER STATIC AND DYNAMIC CONDITIONS – EFFECTS OF
R. H. Mc Daniel 15 Apr. 1964 25 p
(Contract AF 33(657)-11214)
(FGT-2767; AD-436701)

A dynamic pump loop system, was operated for 20 hours in a nonnuclear environment to establish base line data on functional fluid GTO-915, high-temperature jet-engine lubricating oil. The system was then subjected to operation in a nuclear environment. Dynamic and static oil samples were taken periodically during both runs to determine physical and chemical property changes of the test fluids. Average bulk oil temperature within the static and dynamic reservoirs was 300° F. System operation and fluid characteristics, with the exception of increased coking tendency at 700° F, were satisfactory during the preirradiation run. System operation was also satisfactory during the 23-hours irradiation run. Properties most adversely affected were neutralization number, thermal, and oxidation stabilities and lubricating characteristics. Moderate viscosity increases were also noted. However, the fluid displayed good flash point and shear stability characteristics during the exposure run. Degradation of GTO-915 was definitely the result of synergistic effects of operation plus irradiation. Author

N64-20047 General Dynamics/Fort Worth, Tex.
MATERIALS – SOLID FILM LUBRICANTS – IRRADIATION BY THE GTR AND Co^{60} SOURCES – EFFECTS ON WEAR-LIFE
J. W. Head 15 Apr. 1964 7 p
(Contract AF 33(657)-11214)
(FTDM-3006; AD-438132)

Three solid-film lubricants were tested to determine wear-life characteristics after irradiation at ambient chamber temperature in the Ground Test Reactor (GTR). No significant effects were produced. Testing was not done for effects of cobalt 60. A.W.

N64-20049 General Dynamics/Fort Worth, Tex.
MATERIALS – CERAMIC BONDED SOLID FILM LUBRICANTS – EFFECTS OF IRRADIATION AND HIGH TEMPERATURE ON
J. W. Head 15 Apr. 1964 8 p
(Contract AF 33(657)-11214)
(FTDM-3053; AD-438137)

Film A (molybdenum disulfide + lead sulfide + boric oxide) would operate with friction coefficients of 0.4 or less only at 1000° F and so was tested only at that temperature both before and after irradiation. There was no significant effect due to exposure to reactor radiation. Film B (calcium fluoride + oxide frit) was unable to carry the prescribed load at any temperature, and so was deleted from the program. No significant effects were noted from wear life determinations conducted at 600° F and 1200° F on Film C (molybdenum disulfide + graphite + sodium silicate). A.W.

N64-20051 General Dynamics/Fort Worth, Tex.
WING PIVOT – DRY FILM LUBRICANT EVALUATION
J. D. Reynolds 15 Apr. 1964 9 p
(Contract AF 33(657)-11214)
(FTDM-3113; AD-437609)

One of the most promising methods of lubricating the wing pivot on the F-111 is to use a solid film lubricant. A test was performed on seven commercial resin-bonded solid film lubricants to determine the three most promising methods. Testing was performed on the Hohman A-6 test machine. The three lubricants showing the most satisfactory wear life under test conditions were Alpha Molykote X-106, Surf-Kote M1284, and Almasol X-38. A.W.

N64-20063 General Dynamics/Fort Worth, Tex.
MATERIAL – ADHESIVES – AEROBOND 500, DYNABOND 132 – CREEP RUPTURE – TEST OF
15 Apr. 1964 9 p
(Contract AF 33(657)-11214)
(FTDM-3197; AD-438141)

Creep properties of Aerobond 500 could not be determined because the first specimen blew apart during postcure at atmospheric pressure; the second, postcured under 50-psi pressure, did not blow apart, but the skin-to-core bond was ruined (as shown by flatwise tension tests). Panels bonded with Dynabond 132 bend or deflect more than brazed panels. Panels were under a creep load of 410 lbs or 115-psi core shear load. Neither Dynabond 132 nor the brazed panel had any permanent set after 10 hours at 420° F and after 30 minutes at 490° F—the average set for the three Dynabond 132 panels was 0.005 in. as compared to 0.009 in. for two brazed panels. A.W.

N64-20065 General Dynamics/Fort Worth, Tex.
CORROSION PROTECTION COATINGS FOR USE IN F-111 INTEGRAL FUEL TANKS – SCREENING TEST OF
Gale E. Wood 15 Apr. 1964 7 p
(Contract AF 33(657)-11214)
(FTDM-3211; AD-437602)

Screening tests were conducted on Dow Corning's Q94-507 Corrosion Protection Coating and Shell's Chromate Blend Primer by subjecting them to conditions simulating the environment of the F-111 integral fuel tanks. Results concerning adhesion, resistance to salt water and fuel, and low-temperature flexibility are given. The Q94-507 looked very favorable in all the tests conducted; it is noted that this material turned dark in color, but remained transparent when exposed to 375° F heat aging. The Chromate Blend Primer, when immersed in the two layer salt water–jet reference fluid, was removed by the fuel layer, but it passed all other tests. R.L.K.

N64-20066 General Dynamics/Fort Worth, Tex.
MATERIAL – ADHESIVES – AF-33, AF-130 AND METLBOND 329 – ENVIRONMENTAL EXPOSURE OF
J. P. Thomas 15 Apr. 1964 22 p
(Contract AF 33(657)-11214)
(FTDM-3202; AD-437886)

Tests were made to determine the effects of MIL-A-5090D environmental-exposure requirements on the lap shear strength of AF-33 and on the flatwise tension strength of AF-130 and of Metlbond 329 when tested after exposure at 75° ±3° F. These adhesives are being considered for the F-111 airplane. No significant degradation due to the environmental exposures was determined. R.L.K.

N64-20067 General Dynamics/Fort Worth, Tex.
EMPIRICAL DATA, COMPOSITE FIBERGLASS – METAL INSULATION PANELS FOR F-111 STUDY, TRANSIENT TEMPERATURE RESPONSE OF
15 Apr. 1964 9 p
(Contract AF 33(657)-11214)
(FTDM-3219; AD-437590)

Tests were made to determine the transient temperature response of six thermal-insulation panel constructions. Results indicated that the filling of the fiberglass core with glass microspheres lessened rather than improved the insulation properties of the panel. Also, the coating of the phenolic surface with acrylic paint FMS-1004 did not significantly affect the insulation properties of the panel. R.L.K.

N64-20072 General Dynamics/Fort Worth, Tex.
PLASMA ARC DEPOSITION FOR AEROSPACE APPLICATIONS
J. E. Halkias, H. R. Thornton, and J. E. Burroughs 15 Apr. 1964 29 p Presented at the 3d Aerospace Finishing Symp., Am. Electroplaters Soc., Dallas, 16–17 Jan. 1964
(Contract AF 33(657)-11214)
(FZM-4044; AD-438469)

The plasma-arc spray process demonstrated potential as a material-deposition method for the aerospace industry. Current applications using the plasma-arc spray technique are presented and their feasibilities discussed. The principal areas considered are coatings, including oxidation, wear, and erosion resistant, temperature control, and lubrication applications, fabrication of refractory metal shapes, plasma fusion surfacing, and controlled environment spraying. Author

N64-20079 General Electric Co., Syracuse, N.Y.
SILICON PLANAR EPITAXIAL TRANSISTOR TYPE 2N2193, SILICON GROWN DIFFUSED TRANSISTOR TYPE 2N336 Seventh Quarterly Report, 31 Oct. 1963–31 Jan. 1964
P. W. Olski et al [1964] 27 p
(Contract DA-36-039-SC-86727)
(AD-439232)

Reliability estimation and failure analysis of the type 2N2193 transistor is discussed. It was found that the majority of failures produced by 500 hours of testing are of the bulk type, and, also, failures found at 1.2, 1.4, and 1.6 watts are not of the same type as found at the rated 0.8-watt level. Most of the failures were CE shorts, increasing in number with time and with power level, whereas at the 0.8-watt level, most of the failures occurred by an EB shorting mode. Units of transistor type 2N336 taken from the production run have completed stress screening and have been put on various power-life tests for reliability estimate. Preliminary analysis of the 168-hour data and thermal-resistance data indicates that stresses producing junction temperatures over 280° C cause thermal runaway of the device and apparently produce irreversible bulk failure mechanisms. P.V.E.

N64-20103 Metals and Controls, Inc., Attleboro, Mass.
STUDY OF DUCTILE COATINGS FOR THE OXIDATION PROTECTION OF COLUMBIUM AND MOLYBDENUM ALLOYS Bimonthly Progress report No. 4, 1 Jan.–29 Feb. 1964
E. H. Girard and J. J. Buchinski 31 Mar. 1964 36 p refs
(Contract NOw-63-0706-c)
(AD-434441)

Oxidation loss rates for platinum and platinum-10% rhodium alloy samples were 1.98 and 2.40 μ in./hr, respectively, at 2,550° F in an airflow of 480 ipm. In the absence of interdiffusion of coating and base metal, 2.5 mils of platinum protected the base metal for 100 hours at 3,000° F in an airflow of 480 ipm. An increase in dew point from about −40° F to 120° F for the air used in testing had an insignificant effect on the oxidation rate of pure platinum at 2,200° F and 2,550° F in an airflow of 24 ipm. Platinum does not react with water vapor at these temperatures, and an increase in humidity served to provide an increased percentage of nonreactive gas in the test atmosphere. Tests on coating-base metal composites showed coated TZM and FS-85 to be attacked differently. Molybdenum from the TZM diffused through the coating and was removed at its surface as a volatile oxide. Oxygen penetrated the coatings on the FS-85 samples in a discontinuous manner, causing blisters of oxide to be formed. Author

N64-20109 Crystalonics, Inc., Cambridge, Mass.
PRODUCTION ENGINEERING MEASURE TO IMPROVE PRODUCTION TECHNIQUES AND TO INSURE TO RELIABILITY OF THE C600 SERIES FIELD EFFECT TRANSISTORS Quarterly Report No. 2, 1 Oct.–31 Dec. 1963
John R. Williams [1963] 39 p
(Contract DA-36-039-AMC-01483(E))
(AD-437700)

The current program status included: (1) A determination of the effect of the four parameters associated with the oxidation system was completed. It was determined empirically that

the best settings for these parameters are: (a) furnace temperature, 1,100° C; (b) time duration, 1 hour; (c) water temperature, 90° to 95° C; and (d) oxygen flow rate, 3 l/min. (2) A Kulicke and Soffa Model 447 nailhead bonder was adopted for use with the ultrasonic welder. (3) New masks providing for internal shorting of the grids proved to be satisfactory. (4) A final design for the mesa etching fixture was fabricated. The fixture allows for heat transfer away from the silicon slice being etched. (5) Several diodes were manufactured. I.v.L.

N64-20132 Texas Instruments, Inc., Dallas Semiconductor-Components Div.
PRODUCTION ENGINEERING MEASURES TO INCREASE TRANSISTOR RELIABILITY Quarterly Progress Report No. 4, 1 Feb. 1963–30 Apr. 1963
[1963] 32 p
(Contract DA-36-039-SC-86730)
(Rept. 03-63-29; AD-433496)

The purpose of this program is to establish the engineering measures necessary for the attainment of a maximum operating failure rate of 0.01% and 0.001% per 1,000 hours, at a 90% confidence level, on the 2N960 series of germanium epitaxial mesa transistors, and on the 2N744 silicon nonplanar epitaxial type, respectively. The current status of the following areas is presented: (1) epitaxial growth control; (2) surface preparation of substrates for crystal growth; (3) epitaxial continuity control; (4) diffusion control to eliminate the resistivity-product problem; (5) protective-coating techniques for surface passivation; (6) cleaning techniques to obtain optimum surface conditions for all fabrication processes; (7) welding techniques for encapsulation and sealing; (8) controlled formation of surface oxide for surface stabilization; (9) protective inert coatings for surface stabilization; (10) evaporation control; (11) mesa and dice cutting; (12) piece-part incoming inspection procedures; (13) post can stressing for the 2N960 series; (14) quality-assurance testing; (15) stripe alloying; and (16) thermocompression bonding. I.v.L.

N64-20141 Westinghouse Electric Corp., Youngwood, Pa.
PRODUCTION ENGINEERING MEASURE TYPE 2N1814 SILICON ALLOY TRANSISTOR Quarterly Progress Report No. 2, 1 Oct.–31 Dec. 1963
T. Csakvari, P. Kannam, G. Mellot, D. Moore, R. Pisarcik et al
[1963] 30 p
(Contract DA-36-039-AMC-03617(E))
(AD-437189)

The status of all phases of the reliability improvement program is presented. Problems encountered during the fabrication of devices and procedures designed to eliminate the difficulties are discussed. The method for determining failure rate for present product through the use of 1,000-hour operating life test is described. Author

N64-20143 Western Electric Co., Inc., Laureldale, Pa.
MECHANIZATION OF SEMICONDUCTOR DEVICES Quarterly Progress Report No. 24, Oct. 1, 1963–Dec. 31, 1963
M. N. Reppert [1963] 40 p
(Contract DA-36-039-SC-72729)
(AD-433812)

The following areas of activity dealing with machines for mechanizing transistor production are discussed: (1) refinement of present production machines; (2) wire bonding; (3) stripe evaporation and alloying; (4) header thermal capability; (5) wire welding; (6) material handling; (7) diffusion; (8) silicon dioxide coating; and (9) header internal lead trimming. P.V.E.

N64-20190* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
SURFACE FAILURE OF ALUMINA BALLS DUE TO REPEATED STRESSES APPLIED IN ROLLING CONTACT AT TEMPERATURES TO 2000°F
Richard J. Parker, Salvatore J. Grisaffe, and Erwin V. Zaretsky
Washington, NASA, May 1964 18 p refs
(NASA TN D-2274) OTS: $0.50

The five-ball fatigue tester was used to study the behavior of alumina balls under repeated stresses applied in rolling contact. Hot-pressed and cold-pressed-and-sintered 1/2-in. alumina balls were tested at 80° and 700° F, maximum Hertz stresses of 250,000 to 650,000 psi, a contact angle of 20°, and a shaft speed of 950 rpm with a mineral oil lubricant. Failure appearance in alumina was unlike fatigue pits found in bearing steels and a crystallized-glass ceramic. Failure appearance and rate of progression were similar for hot-pressed and cold-pressed-and-sintered alumina. Tests at 80° F with mineral oil lubrication over a range of stresses show that life varies inversely with stress raised. Tests showed that both types of alumina had shorter lives and lower load capacities at a race temperature of 700° F than they did at 80° F. Failure appearance and rate of progression at 700° F were similar to those at 80° F for both hot-pressed and cold-pressed-and-sintered alumina. Author

N64-20192* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
FRICTION AND WEAR OF NICKEL-ALUMINUM ALLOYS AND SOME SULFUR-MODIFIED STEELS IN VACUUM TO 10^{-9} MILLIMETER OF MERCURY
Donald H. Buckley and Robert L. Johnson Washington, NASA, May 1964 21 p refs
(NASA TN D-2307) OTS: $0.50

The friction, wear, and welding characteristics of 52100, 440-C stainless steel, and M-2 tool steel with and without the addition of 0.4- to 0.5-percent sulfur were studied in vacuum (10^{-9} mm Hg). Studies were also conducted with simple nickel–aluminum binary alloys in vacuum. Friction and wear studies were made with a hemispherical (3/16-in.-rad.) rider, which slides in a circular path on the flat surface of a rotating metal disk of the same metal. The specimens in vacuum had a load of 1,000 g (2.2 lb), a sliding velocity of 75 to 1960 ftpm, and a temperature of 75° F. The addition of 0.4- to 0.5-percent sulfur to 52100, 440-C, and M-2 reduced friction, wear, and welding normally encountered with these alloys in vacuum. With nickel–aluminum binary alloys friction and wear improved with the addition of aluminum to nickel. A 16.4-percent-aluminum–nickel alloy exhibited lower friction and less wear and metal transfer in vacuum than did two commercial nickel-base alloys. Author

N64-20261 Martin Co., Denver, Colo.
VIBRATION TESTS, AN ESTIMATE OF RELIABILITY
J. L. Rogers *In* Defense Dept. Shock, Vibration and Assoc. Environ., Pt. 3 Mar. 1964 p 189–194 (See N64-20235 13-01)

This paper discusses the use of vibration tests as a tool in the evaluation of component reliability. Test data are presented to show how raw data are tabulated, reduced, and illustrated. Examples of correlation between flight-test-measured reliability and estimates from vibration tests are shown. Author

N64-20268 Massachusetts Inst. of Tech., Cambridge Metals Processing Lab.
DEFORMATION PROCESSING OF ANISOTROPIC METALS Progress Report No. 2, 1 Sep.–31 Oct. 1963

D. H. Avery and W. A. Backofen Dec. 1963 4 p
(Contract NOw-63-0564-d)
(AD-428861)

Efforts were concentrated on further investigations of the plane-strain deformation of α(2.5Sn-5Al) titanium alloy and the variation of plastic anisotropy with temperature and strain. The plastic-strain ratio, R (width thickness strain) of the alloy was determined by micrometer measurements after cooling back to room temperature. The testing temperatures were 500° and 800° F. Results indicated that: (1) The R value at 2% strain decreases with increasing testing temperature. The strains employed were 2%, 6%, 10%, and 15%. (2) The R value for tests in the rolling direction showed little dependence on strain, whereas there was a sharp increase with strain in the transverse direction, the rate of increase becoming greater with increasing temperature. Also, the development of plastic anisotropy in sheet material (aircraft quality AISI 4340) by mechanical means is discussed. Specifically, by drilling closely spaced holes in the through-thickness direction, and either filling with a softer material or even leaving unfilled, the possibility is presented of manipulating R values over substantial ranges. I.v.L.

N64-20289 Battelle Memorial Inst., Columbus, Ohio Defense Metals Information Center
METALWORKING [First] Review of Recent Developments
T. G. Byrer, C. T. Olofson, and F. W. Boulger 3 Apr. 1964 4 p refs
(AD-438735)

Recent developments in metalworking include: (1) Several promising extrusion-die materials have been developed at Nuclear Metals. Hot-pressed silicon nitride–tungsten powder and zircon–tungsten powder showed promise when used as dies for T-shapes. (2) Extrusion and drawing of D-43(Nb-10W-1Zr-0.1C) and Nb-752 (Nb-10W-2.5Zr) H-sections are being investigated at Du Pont. (3) Two new research programs are under way involving the production of Ta-alloy tubing. The greatest potential use for such tubing is in nuclear aerospace application. (4) The effects of supplying vibrational energy in frequencies between 60 and 40,000 c/s to grinding surface operations have been investigated by Sheffield Corporation. A wheel vibrating in the 20,000 c/s frequency range gave the best results. (5) Arde-Portland Inc. has developed a cryogenic metalworking process, called Ardeforming, that can stretch Type 301 stainless-steel containers to final shape by pressurization at cryogenic temperatures. This method appears to be useful in fabricating rocket motor casings. (6) Procedures for shearing tungsten have been refined. The tungsten sheet is, first, either painted with graphite or oxidized in the shearing area, and then placed on the bed of a 12-foot shear that is insulated with a tapered sheet of transite. A heating assembly containing a quartz lamp is then lowered to within 1 in. of the painted sheet surface. I.v.L.

N64-20298 Raytheon Co., Lexington, Mass. Semiconductor Div.
PRODUCTION ENGINEERING MEASURE RELIABILITY IMPROVEMENT SILICON ALLOY TRANSISTOR, VOLUME III Final Engineering Report
15 Nov. 1963 245 p
(Contract DA-36-039-SC-86744)
(QC-223; AD-438981)

This manual is a compilation of several volumes of working documents. In-plant and general divisional procedures, materials-process specifications and prints, assembly-process specifications and prints, test specifications and procedures, and quality-inspection procedures are presented in separate groupings. R.T.K.

N64-20310 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ENERGY PROPERTIES OF THE ELECTRIC WELDING ARC
G. M. Tikhodeyev 6 Aug. 1963 307 p refs Transl. into ENGLISH of the book "Energeticheskiye Svoystva Elektricheskoy Svarochnoy Dugi" Moscow, Izd. AN SSSR, 1961 p 1–254
(FTD-TT-62-1818/1+2; AD-415122)

The results of broad experimental research of the electric arc as applied in welding techniques are given. Numerous statistical properties of arc discharges are cited (up to 2,000), and a theory of approximation is set up allowing for the computation of these properties. The influence of magnetic fields on the arc discharge is analyzed. Ways are indicated for improving the technological properties and for increasing the economy of the welding arc. Other applications of the arc—in lighting techniques, electrothermics, for the design of electrical apparatus—are included. Author

N64-20319 Ohio State U. Research Foundation, Columbus
NONDESTRUCTIVE SYSTEM FOR INSPECTION OF FIBER GLASS REINFORCED PLASTIC MISSILE CASES AND OTHER STRUCTURAL MATERIALS Ninth Quarterly Technical Report
Jay P. Mitchell and Robert C. Mc Master Nov. 1963 38 p refs
(Contract DA-33-019-ORD-3670)
(WAL-TR-142.5/2-8; AD-434819)

Evaluation tests of the scan-converter image storage system indicated that it greatly improved the contrast range of low-signal-level X-ray television images. Tests indicated that the storage system could be utilized to display a continuous television X-ray image obtained by intermittent-scan operation of the television camera chain. A contrast sensitivity of 2 percent through 1/2-in.-thick steel was visualized on the television monitor screen by using intermittent-scan operation of the television camera chain and the image storage system. Evaluation tests were conducted on experimental 2-in.-diam X-ray-sensitive television camera tubes. Equipment was fabricated to make lag response tests of 1-in., X-ray-sensitive, camera tubes. An evaluation test was made of the relative sensitivities of X-ray-sensitive camera tubes operated in a slow-scan television camera. The measured test results indicated that tubes with thin selenium targets had the greatest sensitivity to X-radiation. Author

N64-20321 Aberdeen Proving Ground, Md. Coating and Chemical Lab.
PAINT STRIPPER FOR USE ON MILD STEEL AND ALUMINUM
Joseph T. Crockett 25 Feb. 1964 29 p
(CCL-159; AD-438985) OTS: $1.00

The object of this project is the removal of all types of paints and related films from all surfaces quickly and efficiently. Industry solves this problem by providing different paint removers for different paints. For the military a "single" system is needed to sufficiently loosen all paints and related films from metal surfaces, chiefly mild steel and aluminum, so that the loosened paint may be washed away with a stream of water. Several acid type paint strippers on the market were studied leading to new theories and insights as to why acid type paint removers are effective. From these new theories, it was possible to plan a study of related compounds and formulations to result in a more efficient and more universally applicable paint remover. The first formulation presented a safety problem in materials handling and waste disposal; the component causing the difficulties was eliminated. To render the formulation noncorrosive to the desired metal, further work was done to find a suitable inhibitor, leading to

final formulation, that is noncorrosive to mild steels and aluminum even when galvanically coupled. This final formulation was then retested on all types of paints used for military purposes, and was highly efficient, achieving all objectives desired for mild steel and aluminum. Author

N64-20324 Raytheon Co., Lewiston, Me. Semiconductor Div.
PRODUCTION ENGINEERING MEASURE ON SILICON ALLOY TRANSISTORS, VOLUME I Final Engineering Report, 25 Jun. 1962-26 Dec. 1963
R.W. Jones, A. W. Postlethwaite, and L. F. Leary [1963] 133 p refs
(Contract DA-36-039-SC-86744)
(QC-223; AD-438979)

Values and controls for silicon resistivity, lifetime, orientation and crystalline perfection were determined. The mechanical design and methods of assembly were changed to give lower T_j, to permit higher stressing levels, and to insure cleaner junctions. Electrolytic and vibratory etching were developed and optimized. Improved basecoat curing and nitrogen packaging were implemented. A combination of 200° C bake and 400 mw burn-in post seal stabilizing stress was proven optimum. Power step stress as a rapid reliability ranking method was shown to be effective. A production run was carried out and the improved reliability of the product demonstrated. A complete process manual, an approved inspection and quality control plan, consolidated production run data (including yields, parameter distributions, and characteristic parameter curves), and photographs of all special equipment are included as required by the contract. Author

N64-20325 Raytheon Co., Lewiston, Me. Semiconductor Div.
PRODUCTION ENGINEERING MEASURE; RELIABILITY IMPROVEMENT; SILICON ALLOY TRANSISTOR. VOLUME II: PROCESS SPECIFICATION MANUAL Final Engineering Report
[1963] 239 p
(Contract DA-36-039-SC-86744)
(QC-223; AD-438980)

Areas of specification discussed include: (1) raw-material properties; (2) silicon-chip preparation; (3) alloying; (4) transistor assemblage; (5) quality control; and (6) care and handling of equipment and material. I.v.L.

N64-20361 Martin Co., Baltimore, Md.
MANUFACTURING METHODS AND DESIGN PROCEDURES OF BRAZED REFRACTORY METAL HONEYCOMB SANDWICH PANELS Final Report, 20 Nov. 1961-20 Sep. 1963
J. W. Mc Cown, C. R. Wilks, L. J. Gagola, A. Norton, and M. Schwartz Wright-Patterson AFB, Ohio, Aeron. Systems Div., Nov. 1963 183 p refs
(Contract AF 33(657)-7276)
(ASD-TDR-63-767; AD-428150)

Manufacturing methods and design procedures were developed for fabricating details and vacuum brazing of TZM (Mo-0.5Ti-0.07Zr) molybdenum and D-36 (Cb-10Ti-5Zr) columbium alloy honeycomb sandwich panels. These included the marforming of thin sheet, the welding and finishing of honeycomb core, and the high-temperature vacuum brazing of honeycomb sandwich panels. Panels simulating a heat shield and a structural application on aerospace vehicles were designed, fabricated, and tested at temperatures up to 2,600° F. The capability of fabricating, coating, and utilizing brazed-columbium sandwich panels on aerospace vehicles, with the required design procedures for application at temperatures up to 2,400° F, was demonstrated. Only partial success was achieved with the TZM molybdenum alloy, because of severe welding problems encountered in edge sealing of TZM panels. All joints could be electron-beam welded, but sporadic cracking upon cooling could not be eliminated. Author

N64-20389 Virginia U., Charlottesville Research Labs. for the Engineering Sciences
RESEARCH INVESTIGATION OF MAGNETIC AND ELECTRIC FORCES FOR ROTATING SHAFT SUSPENSION Technical Quarterly Progress Report, Sep.-Nov. 1963
M. G. Foster Jan. 1964 19 p refs
(Contract AF 33(657)-8352)
(EMI-3421-105-64U; AD-428853)

Refinements of the design of servomagnetic-support bearings and attempts to introduce damping into a resonant-circuit support are discussed. The active radial bearing system was modified to increase its flexural stiffness and to decrease the tendency for the servoresonance to become locked in with the shaft-flexure vibrations. The resonant magnetic bearing system was damped heretofore by a mass load coupled through viscous material (modeling clay) whose shear could absorb vibration energy to prevent buildup of significant oscillations. Several opportunities less makeshift than this previous practice are under exploration; none is considered an acceptable solution to this problem. Author

N64-20407 Frankford Arsenal, Philadelphia, Pa. Pitman-Dunn Inst. for Research
JOINING OF STEEL AND OTHER WEAR-RESISTANT METALS TO ALUMINUM ALLOYS
M. S. Orysh, I. G. Betz, and F. W. Hussey Aug. 1963 62 p refs
(FA-M64-8-1; AD-428299)

The joining of steel and other wear-resistant metals to aluminum alloys was investigated by reviewing the literature, investigating arc welding and diffusion bonding, and evaluating pertinent commercial products. It was found that 2024 aluminum alloy can be welded to steel that has been coated with either zinc, aluminum, or a silver alloy, provided the welding arc is directed toward the aluminum member of the joint. The diffusion bonding process can be used to join 2024 aluminum alloy to silver alloy-coated steel. The surface hardness of aluminum alloy plates can be increased through the application of an experimental hard-surfacing aluminum alloy or metallized coating. Commercial bimetal products in sheet, plate, or tube form could be used as transition materials.
Author

N64-20486 Texas Instruments, Inc., Dallas Materials and Controls Div.
QUALITY ASSURANCE MANUAL
E. O. Vetter, Ralph F. Stroup, and V. E. Paulos Oct. 1963 101 p

This manual presents the objectives and methods of operation for materials and sensors quality assurance to assure and improve the high quality of the products produced. These products include raw silicon, single crystals, single slices, silicon reverse structure (n-on-p) solar cells, and indium antimonide and indium arsenide photovoltaic, mercury-doped and copper-doped germanium photoconductive infrared detector cells. Areas discussed include: (1) drawing and specification; (2) incoming material; (3) deionized water and gas control; (4) gage control; (5) test-equipment control; (6) process control; (7) final acceptance; (8) reliability engineering; (9) facilities; and (10) materials returned by customers. I.v.L.

N64-20506 Bureau of Mines, College Park, Md.
A SMALL ALUMINA REDUCTION CELL

David Schlain, Charles B. Kanahan, and Joseph H. Swift 1963 46 p refs
(BM-RI-6265)

A small alumina reduction cell with a graphite crucible and boron nitride liner was developed as the initial phase of a study of the reactions occurring in the reduction of alumina by the Hall-Heroult process. Operating conditions in the cell such as temperature, time, current density, electrolyte composition, and electrode materials may be varied easily. Aluminum was produced in the cell at a current efficiency of about 75% and a cell voltage of 2.7 volts. Although the data are not wholly conclusive, the operation of the cell was greatly affected by large changes in temperature, electrode spacing, current density, and alumina concentration in the electrolyte. Author

N64-20518 Lockheed Missiles and Space Co., Sunnyvale, Calif.
THERMIT WELDING Selective Bibliography, 1940-1962
Scott J. Buginas, comp. Feb. 1963 21 p refs
(SB-63-25; Rept. 5-72-63-7)

This bibliography contains 59 selected references on thermit welding from the literature of 1940–1962. The prime interest areas of the search were in joining aluminum by this process and in joining heavy plate. Brief abstracts are included with most citations to expand title information. Abstracts are arranged in alphabetical order by author's name. Author

N64-20556 Bureau of Mines, College Park, Md.
METHODS FOR PRODUCING ALUMINA FROM CLAY: AN EVALUATION OF THREE SULFURIC ACID PROCESSES
Frank A. Peters, Paul W. Johnson, and Ralph C. Kirby 1963 65 p refs
(BM-RI-6229)

A series of evaluations is being made to determine the relative processing costs of producing metallurgical-grade alumina from low-grade aluminous materials. These evaluations include the estimated operating and capital costs as well as recommendations for additional research and development to improve the processes and to lower their costs. The design for each process is based on published work. The three processes considered in this evaluation are designed to leach alumina as aluminum sulfate from calcined clay with sulfuric acid and to remove the silica residue by filtration. The filtrate from leaching is then purified by one of the following methods: removal of iron in electrolytic cells using mercury cathodes; removal of iron by chemical precipitation through the formation of an iron–manganese complex; or precipitation of the alumina from an aqueous ethanol solution, leaving iron in solution. Author

N64-20577* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
LUBRICANTS AND MECHANICAL COMPONENTS OF LUBRICATION SYSTEMS FOR A SPACE ENVIRONMENT
Robert L. Johnson and Donald H. Buckley Washington, NASA, 1964 24 p refs Presented at the Am. Soc. of Lubricating Engr. Aerospace Council Meeting, Chicago, 28 May 1964
(NASA TM X-52031) OTS: $2.60 ph

This report concerns: (1) design criteria for rolling-contact bearings, sliding bearings, gears, and dynamic seals; (2) component designs for various types of bearings and gears; (3) materials for bearings surfaces; (4) lubrication methods and materials; (5) proof testing of lubricated components; (6) the survey and determination of vacuum evaporation characteristics for lubricated materials; and (7) a review of the state-of-the-art of lubricants and mechanical components of lubrication systems for a space environment. I.v.L.

N64-20654 Joint Publications Research Service, Washington, D.C.
STUDIES IN WELDING OF TITANIUM AND NIOBIUM
8 May 1964 67 p refs Transl. into ENGLISH of 2 articles from Russian publ.
(JPRS-24521; OTS-64-31229) OTS: $1.75

CONTENTS:

1. WELDING OF TITANIUM ALLOYS M. V. Poplavko, N. N. Manuylov, and L. A. Gruzdeva p 1–58 refs (See N64-20655 13-17)

2. WELDING OF NIOBIUM BY VACUUM ARC AND ELECTRON BEAM MELTING Ye. I. Istomin and Yu. P. Gumenyuk p 59–64 (See N64-20656 13-17)

N64-20655 Joint Publications Research Service, Washington, D.C.
WELDING OF TITANIUM ALLOYS
M. V. Poplavko, N. N. Manuylov, and L. A. Gruzdeva *In its* Studies in Welding of Titanium and Niobium 8 May 1964 p 1–58 refs Transl. into ENGLISH from Russian book "Svarka Tsvetnykh Metallov i Splavov—Sbornik Statey", Moscow, 1961 p 72–110 (See N64-20654 13-17) OTS: $1.75

Among the subjects discussed are the following: preparation of surfaces for welding; readiness of titanium for welding; certain technologies in use in welding titanium and its alloys; heat treatment of welded parts; the influence of aluminum, tin, zircon, molybdenum, etc. on the properties of welded joints; and the influence of alloys on angles of bend of welded seams. A.W.

N64-20656 Joint Publications Research Service, Washington, D.C.
WELDING OF NIOBIUM BY VACUUM ARC AND ELECTRON BEAM MELTING
Ye. I. Istomin and Yu. P. Gumenyuk *In its* Studies in Welding of Titanium and Niobium 8 May 1964 p 59–64 Transl. into ENGLISH from Avtomat. Svarka (Kiev), no. 1, 1964 p 25–27 (See N64-20654 13-07) OTS: $1.75

Methods are investigated for welding niobium of varying purity. Experiments were conducted on metal by vacuum arc and electron beam melting using cathode ray, argon arc welding, and welding in a chamber with controlled atmosphere. The difference in hardness of niobium obtained by vacuum arc and cathode ray melting constitutes 60 to 70 HV in the initial state. It is concluded that niobium lends itself to cathode ray melting as well as to argon arc welding. A.W.

N64-20717 Atomic Energy Commission, Washington, D.C. Div. of Technical Information
RADIATION PASTEURIZATION OF FOODS Summaries of Accomplishment
[1963] 183 p refs Summaries of Papers Presented at the 3rd Ann. Contractors Meeting, 23–24 Oct. 1963
(TID-7684) OTS: $2.75

Summaries of accomplishments in radiation pasteurization of marine food products, fruits, and vegetables are presented. The wholesomeness of some irradiated foods is evaluated. Public health safety in consumption of these foods is also considered. G.D.B.

18 MATERIALS, METALLIC

Includes cermets; mechanical and physical properties of alloys and metals; and metallurgy. *For related information see*: 07 Chemistry; 17 Machine Elements and Processes; 19 Materials, Nonmetallic; 33 Stresses and Loads; and 34 Structural Design.

N64-20038 General Dynamics/Fort Worth, Tex.
MATERIAL – AMS 6434 STEEL, 180-210 KSI HEAT TREAT WELD REPAIR – FATIGUE TEST OF
S. V. Glorioso 15 Apr. 1964 27 p
(Contract AF 33(657)-11214)
(FGT-2956; AD-437248)

This test program was originated to determine the effect of repair welds on the tensile, impact, and axial fatigue properties of 0.090-in. AMS 6434 used for the assemblies. Butt welds and welds with 50% penetration into the parent metal were examined. Primarily arc weld techniques using Arcoloy 502 coated electrodes were evaluated, although TIG welds were also tested in fatigue. Postwelding procedures of stress relieving, shot peening, or reheat treatment were evaluated. Room-temperature mechanical-property determinations included tensile yield, ultimate, and elongation, notch tensile ultimate, charpy impact, and axial fatigue. All specimens were tested with the weld bead removed. Reheat treatment after welding produced the highest tensile and fatigue properties of any of the conditions tested in the butt welded specimens. Author

N64-20039 General Dynamics/Fort Worth, Tex.
MATERIALS – 4340 STEEL – STRESS CORROSION AND EFFECTS OF BANDING – LITERATURE SURVEY, PART II. EFFECTS OF BANDING
P. F. Ghena 15 Apr. 1964 49 p refs
(Contract AF 33(657)-11214)
(FGT-2957, Pt. 2; AD-438989)

Banding is caused by segregation of the alloying elements in ingots during solidification. During subsequent hot-working operations the segregation is aligned in the direction of working and results in a banded appearance of the microstructure. The diffusion rates of the alloying elements in steel control the homogenization of the ingot, chromium and molybdenum homogenizing readily and nickel very slowly. The increase in properties by homogenizing does not warrant the involved process of homogenizing, then refining the resulting large grain size. The fact that design can orient the plane of maximum stress in a direction parallel to the working direction of the stock or forging makes the involved and costly task of homogenization infeasible. Author

N64-20042 General Dynamics/Fort Worth, Tex.
PLANE STRAIN FRACTURE TOUGHNESS OF LARGE D6ac STEEL SPECIMENS
R. J. Urban 15 Apr. 1964 27 p refs
(Contract AF 33(657)-11214)
(FGT-3064; AD-437250)

Eighteen 2-in. × 2-in. × 24-in. bars of Ladish D6ac rolled steel were tested in a bend test fixture to obtain a plane strain fracture toughness index K_{Ic}. One bar was used to develop a calibration curve. The other seventeen were tested to failure in bending. Of these, eight received the Aus-Bay heat treatment, with air cooling after tempering; four received a heat treatment with no Aus-Bay, and four received a heat treatment incorporating the Aus-Bay and furnace cooling to 500° F after second temper. The first set (Aus-Bay) had the best fracture toughness, the third set was almost as fracture tough as the first set (except for the −65° F data), and the second set (Aus-Bay, furnace cooling) had the least fracture toughness. Author

N64-20043 General Dynamics/Fort Worth, Tex.
MATERIAL – STEEL SANDWICH PANELS – SILVER, COPPER, LITHIUM, BRAZED – CORROSION INHIBITOR FOR – DEVELOPMENT OF
E. W. Turns 15 Apr. 1964 21 p
(Contract AF 33(657)-11214)
(FGT-3066; AD-436735)

Test panels of Ag-Cu-Li brazed 17-7 steel were exposed to 650° F air for one week and then treated in triplicate with 10 different test corrosion inhibitors. These panels and uninhibited controls were then exposed for 6 weeks at the specified humidity. Potassium chromate, sodium-metasilicate, and phosphoric acid showed promise as inhibitors. Phosphoric acid was especially effective and eliminated virtually all corrosion. Since phosphoric acid is an active mineral acid, additional tests were conducted to determine the effects of removing the excess acid. It was shown that rinsing or neutralization treatment of the phosphoric acid inhibited panels prior to drying at 650° F removes the inhibitive effect. Author

N64-20048 General Dynamics/Fort Worth, Tex.
MATERIAL – HRP – 3/8 OX AND 3/4 OX HEXCEL FOAM FILLED CORE – SHEAR STRENGTH AND SHEAR MODULUS – DETERMINATION OF
J. P. Thomas 15 Apr. 1964 10 p
(Contract AF 33(657)-11214)
(FTDM-3048; AD-438136)

Shear strength and shear modulus data of typical sections of the Centaur thermal shroud were needed to evaluate the structural integrity and fabrication processes of the latest design. To obtain this information, shop-fabricated specimens were tested to specification. The span lengths were specified in the test request as 7 in. and 14 in. Test results for foam-filled core specimens indicated higher shear moduli and core shear results with this light density core material as compared to nonfoam-filled core specimens. Results of the 1.75-in. core thickness specimens were according to predictions, but considerable variations were observed in the 0.7-in.-thick core specimens. The specimen configuration, skin thickness, core thickness, and/or span lengths were incompatible with the two span length shear modulus formula. Author

N64-20050 General Dynamics/Fort Worth, Tex.
MATERIAL – BERYLLIUM WAFFLE PANEL – CHEMICAL MILLED, SHEAR TEST OF
J. May 15 Apr. 1964 9 p
(Contract AF 33(657)-11214)
(FTDM-3068; AD-438138)

The test specimen consisted of a 4FTT464 chemically etched beryllium waffle panel, 14 in. x 30 in., previously tested to failure in the compression test. The failed end of the panel was cut away, and a high-nickel steel doubler, capable of transferring shear into the panel, was bonded to this end. The specimen was mounted in a shear jig and enclosed in a plywood and plexiglass box; strain gages were installed; and the test load was applied. The load was cycled once to 50,000 lbs, and then strain gages were zeroed at 1,000-lbs preload. Load was then applied in 10,000-lb increments to failure, and strains were recorded at each increment. Portions of the failed panel were used to perform the metallurgical tests. Failure of the 4FTT464 test specimen occurred at 70,000 lbs. A.W.

N64-20054 General Dynamics/Fort Worth, Tex.
MATERIAL – EVALUATION – CHARPY IMPACT STRENGTH D6AC AND 4330-V STEEL ALLOY
15 Apr. 1964 4 p
(Contract AF 33(657)-11214)
(FTDM-3135; AD-437885)

The well-forged 4330-V (longitudinal direction) and D6ac billet material (long-transverse direction) exceeded an average of 15 foot-pounds Charpy "V" notch impact strength at room temperature and at −65° F. R.L.K.

N64-20055 General Dynamics/Fort Worth, Tex.
MATERIAL – ALUMINUM ALLOYS – DUPLEX THERMAL EXPOSURE – COMPRESSIVE YIELD
E. R. Wolanski 15 Apr. 1964 8 p
(Contract AF 33(657)-11214)
(FTDM-3152; AD-438139)

Three standard tensile and compression control specimens were tested at room temperature for each of the aluminum alloys. The remaining compression specimens were tested after a duplex thermal treatment. Tensile results exceeded the minimums allowable, and two of the alloys were not suited for the application defined in the duplex thermal treatment. The 2024-T851 compression yield strength after duplex treatment showed a maximum loss of 17% at elevated temperature and 1% at room temperature. Tabular summaries and graphs present complete details of these results. A.W.

N64-20056 General Dynamics/Fort Worth, Tex.
MATERIAL EVALUATION – FATIGUE – SAE-4330-V MODIFIED STEEL ALLOY
M. Sargent 15 Apr. 1964 7 p
(Contract AF 33(657)-11214)
(FTDM-3157; AD-438140)

Results are given of high-cycle and low-cycle fatigue tests and of tensile tests on T2V forging specimens notched to provide a K_t of 3. R.L.K.

N64-20060 General Dynamics/Fort Worth, Tex.
MATERIAL EVALUATION OF H-11 HIGH STRENGTH STEEL FOR F-111
W. M. Pratt 15 Apr. 1964 27 p
(Contract AF 33(657)-11214)
(FTDM-3177; AD-437881)

Tests were made to determine the tensile and fatigue properties of forgings, rolled plate, and weldments of H-11 steel that was heat-treated to 220 to 240 ksi. R.L.K.

N64-20061 General Dynamics/Fort Worth, Tex.
PLANE STRAIN FRACTURE TOUGHNESS OF LARGE D6ac STEEL SPECIMENS HEAT TREATED TO 220-240 AND 260-280 KSI STRENGTH LEVEL
15 Apr. 1964 11 p
(Contract AF 33(657)-11214)
(FTDM-3178; AD-437887)

Tests were conducted to obtain the plane strain fracture toughness index (K_{Ic}) for D6ac steel heat treated to the 260 to 280 ksi strength level, and to obtain a comparison of K_{Ic}'s between bar specimens heat treated to 220 to 240 ksi using two different preaustenitizing treatments. The plane strain fracture toughness indexes (K_{Ic}) for the D6ac alloy steels, heat treated to a 260 to 280 ksi strength level, were calculated to be somewhat lower than those indexes for the same type of steel heat treated to 220 to 240 ksi strength level. The nominal bending stresses were also somewhat lower. The plane strain fracture toughness indexes calculated for the bars given the modified process normalize treatment were as high as those for the bars given a standard, air-cool normalizing treatment at the 220 to 240 ksi strength level. The nominal bending stresses for the bars given the modified process normalize were somewhat higher than those obtained for the bars given the standard normalizing treatment. Author

N64-20068 General Dynamics/Fort Worth, Tex.
MECHANICAL PROPERTIES OF 17-4PH STEEL, HOMOGENIZED VERSUS AS RECEIVED CONDITION
M. R. Sargent 15 Apr. 1964 8 p
(Contract AF 33(657)-11214)
(FTDM-3226; AD-438142)

Samples of the steel plate were tested to determine if a homogenizing heat treatment would improve the mechanical properties sufficiently to require homogenization as a prerequisite for the rework of the fuselage lugs on the wear and bearing pivot-test component. The test specimens were homogenized at 2,150° F for 2 hours and air cooled to room temperature. They were then solution heat treated at 1,900° F for one-half hour and air cooled. Some specimens were aged for 1 hour at 900°, 1,000°, or 1,075° F. In addition to the usual tensile properties, a proportional limit was calculated at 0.01% plastic strain. As measured by elongation, the results show a negligible improvement from homogenizing. Homogenizing also improved the uniformity of ductility for each aging condition, but reduced the tensile strength from 2 to 3 percent. As a function of aging condition, the ultimate and yield strengths decreased, whereas the elastic and proportional limits remained constant. R.L.K.

N64-20069 General Dynamics/Fort Worth, Tex.
MATERIAL EVALUATION OF D6ac STEEL EXTRUSION – MECHANICAL AND METALLURGICAL PROPERTIES OF
W. M. Pratt 15 Apr. 1964 15 p
(Contract AF 33(657)-11214)
(FTDM-3234; AD-438779)

The mechanical and metallurgical properties of a D6ac steel extrusion were investigated. Results indicate that: (1) Relatively uniform smooth tensile properties were obtained for the D6ac steel heat-treated to 220 to 240 ksi, regardless of grain directionality or location of the extrusion. The ductility was somewhat lower in the transverse direction. (2) The junction of the legs of the extrusion displayed the highest ultimate strength at the 260 to 290 ksi strength level. Although the ultimate tensile strengths of the two legs were comparable for both the transverse and longitudinal directions, higher yield strength and lower ductility were obtained for the transverse grain direction. (3) The notch tensile ($K_t = 5.7$) strength of the extrusion in the longitudinal grain direction was equal to or slightly greater than the ultimate strength for both heat-treat levels. For the transverse grain direction, the notch tensile strength was equal to or slightly less than the ultimate strength. The notch strength obtained for the extrusion was less than that obtained for D6ac plate and forging at the corresponding strength levels. I.v.L.

N64-20070 General Dynamics/Fort Worth, Tex.
AN INVESTIGATION OF 18 NiCoMo (300) MARAGING STEEL FORGINGS
15 Apr. 1964 12 p
(Contract AF 33(657)-11214)
(FZM-2608; AD-437591)

The mechanical properties of 18-NiCoMo (300) maraging steel forgings were investigated. The ultimate purpose of the investigation is to completely evaluate this high-strength steel for use in critical applications, such as aircraft landing gears. Data, in either graphical or tabular form, are presented on: (1)

the effect of aging on the yield and ultimate strength of the steel forged at 1,950° and 2,350° F; (2) the effect of aging on the notch strength and ductility of the steel forged at 1,950° and 2,350° F; (3) the composition and forging procedure; (4) the notch-toughness properties of the steel; and (5) heat treat response, i.e., the effects of aging temperature and time and grain direction within the forging on F_{tu}, F_{ty}, R.A., % e, and F_{tnu} (K_t = 6.5). I.v.L.

N64-20074 General Dynamics/Fort Worth, Tex.
EVALUATION OF WELDED ARMCO 17-7PH TH1100 STAINLESS STEEL FOR USE IN FABRICATION OF B-58 NACELLE FRAMES
Walter J. Paquette 15 Apr. 1964 37 p refs
(Contract AF 33(657)-11214)
(FZM-4-1147; AD-438780)

Designers of aircraft, in seeking high-strength heat-resistant materials to sustain increasing loads and temperatures required by these aircraft, need to choose a material that considers weight-strength ratios over a range of temperatures, cost of material and fabrication, and fatigue strength. Fabrication cost reduction is primary. A cost study on the B-58 airplane showed considerable savings could be made if the present nacelle frames were fabricated by welding Armco 17-7PH plate stock into built-up frames instead of machining the frames from Armco 17-4PH forged billets. The data presented result from a study to determine the effects of welded construction on the fatigue strength of test specimens similar in design to the B-58 nacelle frames. Author

N64-20075 General Dynamics/Fort Worth, Tex.
COMPRESSION PROPERTIES OF SELECTED ALUMINUM ALLOYS AFTER MULTIPLE TEMPERATURE EXPOSURES
E. J. Watts 15 Apr. 1964 11 p
(Contract AF 33(657)-11214)
(FZM-12-249; AD-438990)

A modification of the Larsen–Miller method was used to calculate tensile allowables of aluminum alloy material after complex exposures. Compression specimens from 7075-T651, 7079-T651, and 2024-T851 plate were tested at both room temperature and elevated temperature after soaking for 300 hours at 270° F, plus soaking for 10 hours at either 320°, 340°, or 355° F. The one-quarter thickness level was used for both 2-in.-thick plate and 2 1/2-in.-thick plate. All material met longitudinal tensile "A" allowables. A.W.

N64-20085 ManLabs Inc., Cambridge, Mass.
INVESTIGATION OF FRACTURE TOUGHNESS IN HIGH STRENGTH ALLOYS [Annual Report] 15 Aug. 1962– 15 Aug. 1963
B. S. Lement, K. Kreder, and H. Tushman Wright-Patterson AFB, Ohio, Air Force Systems Command, Jan. 1964 120 p refs
(Contract AF 33(616)-8155)
(ASD-TDR-62-868, Pt. 2; AD-438963)

An investigation of the fracture toughness of 4335-V steel tempered in the range of 400° to 800° F was carried out based primarily on precracked Charpy impact and slow bend tests of regular and brittle-boundary specimens with thicknesses in the range of about 0.04 to 0.40 in. These tests were supplemented by notched and unnotched tensile tests, and by metallographic and fractographic examinations using both light and electron microscopy. Also studied were 20 panels approximately 0.050-in. thick, 8-in. wide, and 12-in. long consisting of duplicate specimens representing two heats each of five alloys. The identifications of these alloys are René 41-CRT, AM-350-SCT, PH1 5-7Mo RH1100, Ti-8Al-1Mo-1V(triplex annealed), and Ti-6Al-4V (mill annealed). R.T.K.

N64-20093 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
A GENERAL STUDY OF PROCESSES FOR THE REALIZATION OF DESIGN CONFIGURATIONS IN MATERIALS Sixth Interim Technical Report, 3 Oct. 1963-3 Apr. 1964
Paul Rosenthal Wright-Patterson AFB, Ohio, Mfg. Tech. Div., Apr. 1964 102 p refs
(Contract AF 33(600)-42921; Proj. Noes)
(CAL-NM-1559-P-6; ASO-IR-6; AD-437346)

Three categories of energy-material interactions are discussed: embrittlement, oxidation, and high power density effects. The reversibility of embrittlement by a liquid metal is demonstrated in a model experiment and is applied to an embrittlement machining experiment. Local oxidation at room temperature is demonstrated and applied in a combustion machining experiment. High power density effects are investigated by means of laser beams, and the mechanism of material removal is described. Author

N64-20230 Joint Publications Research Service, Washington, D.C.
HARDENABILITY OF BRAND ShKh15, 9KhS AND KhVG STEELS
V. M. Doronin, I. G. Ivanov, Ye. V. Kruchinina, and A. M. Uglova 8 May 1964 18 p refs Transl. into ENGLISH from Standartizatsiya (Moscow), no. 1, Jan. 1964 p 17–23
(JPRS-24520; OTS-64-31228) OTS: $0.50

The hardenability of hypereutectoid tool-alloyed steels was tested by the face testing method, according to All-Union State Standard 5657-51. Results indicate that: (1) The requirements of the toolmakers on the hardenability of steel can be fully satisfied by the use of Kh (ShKh15), 9KhS, and KhVG steels. However, for one or another type or size of tool, the steels must be selected in correspondence with the hardenability inherent to each of these brands of steel. The more deeply hardenable KhVG steel can be used for large-sized tools. (2) The ShKh15 steel, which is hardenable comparatively shallowly, should be used for manufacturing articles of limited sizes. The workers in the bearing industry must determine precisely the maximum size for articles made from this steel. For the parts of large-sized bearings, the more highly alloyed steels (for example, ShKh15SG steel) or averages of the composition of the alloying elements between ShKh15 and ShKh15SG steel should be used. I.v.L.

N64-20266 Naval Research Lab., Washington, D.C.
THE EFFECT OF SPECIMEN SIZE ON THE FATIGUE CRACK-STRENGTH OF CYLINDRICAL SPECIMENS OF HEAT-TREATED 4340 STEEL
E. P. Klier 16 Dec. 1963 17 p refs
(NRL-6012; AD-428226)

Structures subject to severe service loads frequently fail by the development of free-running (brittle) cracks. This type of failure results from the fact that the high-strength properties now desired in structural materials tend to enhance embrittlement, while a number of factors influence the severity of the embrittlement experienced. Factors that are known in some measure to influence the toughness of high-strength steel in addition to strength level are (1) the testing temperature, (2) the specimen size, (3) the specimen geometry, and (4) the strain rate. The principal change introduced in this study is the specimen size, leading to minor variations in the fatigue-notch tensile-strength data. The ductile-brittle transition indicated is critically dependent on tensile strength. Load-elongation curves were taken, and these have allowed the examination of the ductile-brittle transition as established by stress, by strain, and by means of energy absorption. The experiments suggest that the stress–strain relations in certain fracture tests correspond to those measured for the notch tensile test. Author

N64-20287 Battelle Memorial Inst., Columbus, Ohio Defense Metals Information Center
OXIDATION-RESISTANT COATINGS FOR REFRACTORY METALS Review of Recent Developments
W. A. Gibeault and J. J. English 25 Oct. 1963 3 p refs
(AD-435100)

Recent developments with vanadium, columbium, molybdenum, and tungsten as oxidation-resistant coatings for refractory metals are cited. J.E.T.

N64-20288 Battelle Memorial Inst., Columbus, Ohio Defense Metals Information Center
BERYLLIUM Review of Recent Developments
Webster Hodge 8 Nov. 1963 4 p refs
(AD-435098)

Interest was indicated in the use of beryllium in certain types of structures. The properties are listed that can be an advantage in the employment of beryllium as a structural material. A discussion is presented of the mechanism of bonding beryllium joints, the physical metallurgy of beryllium, and the beryllium nuclear problem. C.L.W.

N64-20301 Aberdeen Proving Ground, Md. Coating and Chemical Lab.
THE CORROSIVITY OF MAGNESIUM ALLOYS IN 5 AND 20 PERCENT SALT FOG ENVIRONMENTS
A. P. De Marco 13 Mar. 1964 33 p refs
(CCL-161; AD-438984) OTS: $1.00

The results and analysis of a factorial experiment are presented, undertaken to determine the corrosivity of variously protected magnesium alloys when exposed to 5% and 20% salt fog environments. The investigation considers two lots of magnesium sand castings and one lot of magnesium sheet alloy, each given two preparatory chemical pretreatments and coated with three different batches of a thermosetting epoxy resin coating using two methods of application. For cast magnesium alloy, corrosion was noted to vary widely within and between the alloy lots investigated and their pretreatments. The relative corrosivity of the exposure environments on the alloy lots depended on the pretreatment used. For the more corrosion resistant pretreatment, 20% salt fog was substantially more corrosive than 5%. For the less effective pretreatment, no significant difference in the corrosivity of the two salt fog environments was apparent. For sheet magnesium alloy, corrosion was significantly less extensive and less variable than for cast alloy in both exposure environments. Regardless of the pretreatments, coatings used, and methods of application, 20% salt fog was found substantially more corrosive than 5%. Author

N64-20352 AeroChem Research Labs., Inc., Princeton, N.J.
KINETIC AND AERODYNAMIC ASPECTS OF THE OXIDATION OF METALS BY PARTIALLY DISSOCIATED OXYGEN Semiannual Progress Report, 15 Nov. 1963-15 May 1964
Daniel E. Rosner and H. Donald Allendorf May 1964 27 p refs
(Contract AF 49(638)-1195)
(AeroChem-TN-61; AD-438927)

Using a resistance monitoring technique, the oxidation rate of electrically heated molybdenum and tungsten filaments has been studied over a wide range of oxygen atom concentrations ($2 \times 10^{-3} \leq p_O \leq 5 \times 10^{-2}$ torr) and surface temperatures ($1{,}000° K \leq T \leq 2{,}600° K$) at flow rates such that the observed oxidation kinetics are not falsified by diffusional limitations. Partially dissociated streams are produced in the pressure range 0.7 to 10 torr using a microwave discharge, and O-atom concentrations are determined using the NO_2 light titration technique. Under the conditions investigated the oxides of molybdenum and tungsten volatilize as rapidly as they are formed, and the unprotected metal is subjected to direct attack by oxygen atoms. On molybdenum and tungsten surfaces oxidation probabilities for atomic oxygen are found to be higher than corresponding values for molecular (diatomic) oxygen by up to one to two orders of magnitude, whereas the corresponding activation energies are considerably lower. Author

N64-20378 Battelle Memorial Inst., Columbus, Ohio Defense Metals Information Center
CRACKING IN HIGH-STRENGTH STEEL WELDMENTS – A CRITICAL REVIEW
P. A. Kammer, K. Masubuchi, and R. E. Monroe 7 Feb. 1964 96 p refs
(Contract AF 33(615)-1121)
(DMIC-197; AD-438432)

Terminology was defined. The effects of cracks on weldment properties are discussed, principally from a theoretical viewpoint. The principal theories of both hot and cold cracking and the factors influencing cracking are also discussed. The hot-cracking theories reviewed are (1) the shrinkage–brittleness theory of Pumphrey, Jennings, Medovar, Bochvar, and others; (2) the strain theory of Pellini; (3) Borland's generalized theory; and (4) Movchan's polygonization theory of hot cracking. Since cold cracking is usually associated with hydrogen embrittlement, the planar pressure theory and its modifications, the adsorption theory of Petch et al., and the Troiano theory of hydrogen embrittlement are reviewed. The factors influencing cracking are arbitrarily divided into mechanical, thermal, metallurgical, and service conditions. Discussions of the following are also included: (1) the control of cracking, material selection and welding techniques (such as preheat, stress-relief heat treatment, and peening); and (2) indirect and direct test methods used to study weldment cracking. Author

N64-20392 Battelle Memorial Inst., Columbus, Ohio
SURVEY OF THE CURRENT KNOWLEDGE OF THE DEFORMATION CHARACTERISTICS OF BERYLLIUM AND THE REFRACTORY METALS Quarterly Progress Report No. 2, 14 Sep.-14 Dec. 1963
A. R. Rosenfield, A. H. Claver, M. J. Klein, and W. S. Lyman 13 Jan. 1964 45 p refs
(Contract N600(19)60240)
(AD-428949)

Preferred orientations and high-strain-rate deformation are discussed. Two types of anisotropy are considered—deformation anisotropy and growth anisotropy. The strain-rate spectrum is outlined, and the regions of major interest are identified. The theoretical approaches being used to understand material responses to strain-rate changes are discussed for the various strain-rate ranges. Equations are presented when they are useful in predicting material responses or when they are useful in describing certain concepts. R.T.K.

N64-20401 Technische Hochschule in Wien (Austria) Inst. für Angewandte Physik
INVESTIGATIONS OF RARE EARTH-MANGANESE-ALLOYS (0-25%Mn) Technical Note No. 5
F. Lihl 31 Jul. 1963 30 p refs
(Contract AF 61(052)-609)
(AD-428772)

The following are discussed: (1) preparation of rare earth–Mn amalgams by means of direct reaction between manganese metal and mercury; (2) the preparation of RE-Mn-alloys (0% to 25% Mn) by means of the amalgam process; and (3) the

examination of these alloys by metallographic and X-ray methods. R.T.K.

N64-20405 Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
PILOT PRODUCTION AND EVALUATION OF TANTALUM ALLOY SHEET Quarterly Report No. 7, Nov. 15, 1963-Feb. 15, 1964
R. L. Ammon and R. T. Begley 15 Apr. 1964 35 p refs
(Contract N600(19)59762)
(WANL-PR-M-008; AD-437174)

The evaluation of T-222 (Ta-9.6W-2.4Hf-0.01C) sheet was continued with emphasis on the properties of a second heat of the alloy. The tensile and stress-rupture properties as well as the weld bend ductility of the second heat were superior to those of the first heat of T-222 produced. The evaluation of other Ta-W-Hf alloys showed that increasing the solute concentration of T-222 from 12 to 14 percent resulted in a substantial increase in 2,400° F tensile strength while producing only a slight improvement at 3,000° F. Increasing the carbon content of T-222 from 0.01% to 0.04% resulted in no significant change in mechanical properties. The substitution of nitrogen for carbon in T-222 produced no significant difference in properties. In a phase identification study, Ta_2C and a complex fcc phase were identified, and their presence in T-222 was correlated with mechanical and thermal treatments.
Author

N64-20417 Republic Aviation Corp., Farmingdale, N.Y.
INVESTIGATION OF THE BASIC MECHANISM OF METAL FATIGUE Engineering Progress Report (Quarterly Report No. 3), 1 Jan. 1964-31 Mar. 1964
Louis J. Teutonico and Barry Z. Hyatt 22 Apr. 1964 15 p refs
(Contract NOw-63-0704-c)
(RAC-921-3; RD-QPR-64-619-3; AD-437223)

Copper single crystals of orientations <100>, <110>, and <111> were deformed in tension at room temperature. The attenuation of a 10-mc longitudinal wave propagating in each crystal increased continuously during deformation. The change of attenuation decreased with increasing number of equally favored slip systems. After unloading, each of the crystals exhibited attenuation recovery. Author

N64-20418 Army Materials Research Agency, Watertown, Mass. Materials Testing Lab.
ANISOTROPY OF TITANIUM SHEET IN UNIAXIAL TENSION
Frank R. Larson Dec. 1963 20 p refs
(AMRA-TR-63-36; AD-433722)

Motivated by the attractive predictions of potential strength increases achievable through texture control, an investigation of the mechanical anisotropy of titanium sheet alloys was carried out. This experimental survey of the uniaxial tension anisotropic characteristics was executed on a wide variety of alpha, alpha–beta, and beta alloys of both recent and ancient vintage. It was clearly demonstrated that both the elastic and plastic properties were widely varying in anisotropy. Furthermore, it was found that there was a direct correlation between the elastic and plastic anisotropy. Although considerable variation of anisotropy existed for one alloy, there was a tendency for the all-alpha alloys to be highly resistant to thinning. It was also found that increased amounts of beta stabilizing elements present in the alloy had a tendency to lower this resistance to thinning. An explanation of the alloying effect is suggested from the results of a preliminary study of changing anisotropy with rolling temperature. Author

N64-20474 Argonne National Lab., Ill. Metallurgy Div.
ANNUAL REPORT FOR 1963
Frank G. Foote, Haim H. Chiswik, and Robert E. Macherey 1963 447 p refs
(Contract W-31-109-ENG-38)
(ANL-6868) OTS: $5.50

The program status includes the following engineering areas: (1) the development and fabrication of fast-reactor fuel elements; (2) the development and fabrication of BORAX-V superheat fuel elements; (3) the fabrication of plutonium recycle fuel elements; (4) the development of ceramic fuels and high-absorbency materials; (5) the experimental irradiation of fuel and control materials; (6) the examination of full-scale reactor fuel elements; (7) the development of corrosion-resistant jacketing and structural materials; (8) the development of fabrication methods for tubing, thorium–uranium fuel materials, high-temperature reactor jackets, ultrathin metallic foils, and superconducting wire; and (9) the development of nondestructive testing methods. Also, the status of the basic metallurgy related to the above mentioned engineering areas is discussed.
I.v.L.

N64-20547 Lockheed Missiles and Space Co., Sunnyvale, Calif.
JOINING OF BERYLLIUM AND ITS ALLOYS BY WELDING AND/OR BRAZING: AN ANNOTATED BIBLIOGRAPHY
Jack B. Goldman, comp. Aug. 1963 37 p 90 refs
(Contract NOrd-17017)
(SB-63-61)

Intense investigation has been made of the problem of joining beryllium and its alloys either by welding and/or brazing during the past 3 years, 1960 to 1963. This annotated bibliography is the result of the examination of printed matter for that period as found in the journal and report literature.
Author

N64-20563 Battelle Memorial Inst., Columbus, Ohio Defense Metals Information Center
BERYLLIUM. REVIEW OF RECENT DEVELOPMENTS
Hugh D. Hanes 8 May 1964 4 p refs
(AD-440083)

A series of beryllium–aluminum "alloys" called Lockalloy have been developed. In a metallurgical sense, these are not alloys but rather dispersions of beryllium particles in a more ductile aluminum matrix. The mechanical and physical properties of these alloys are listed. Lockalloy loses strength less rapidly at elevated temperatures than aluminum- and magnesium-base alloys and has a superior strength-to-weight ratio. A marked decrease in the yield strength of polycrystalline beryllium was noted with increasing ultrasonic input. It is postulated that the ultrasonic energy was attenuated to dislocation sites, thus increasing dislocation mobility. The implications are that, with ultrasonics coupled to standard equipment, lighter machinery could be used for comparable operations. Tensile and compressive properties of beryllium, tungsten, and TZM molybdenum alloy were improved by the application of very high hydrostatic pressure. A new drilling technique for beryllium has been developed. By using a modified spade drill in a tornetic drill, drilling times are reduced to approximately 30 seconds in 1/8-in-thick beryllium plate. Also, the possibility of spalling on the exit surface is virtually eliminated by this technique. This is especially significant in the manufacture of Minuteman spacers. I.v.L.

N64-20565 IIT Research Inst., Chicago, Ill. Technology Center
VANADIUM ALLOY STUDIES Bimonthly Report No. 1, 1 Feb. 1964-31 Mar. 1964

D. Weinstein and F. C. Holtz 16 Apr. 1964 13 p refs
(Contract NOw-64-0239-c)
(IITRI-86021-1; AD-438875)

Vanadium development studies have the primary objective of producing improved short-time (15-min to at least 1-hr) creep and stress-rupture properties at temperatures in the 2,000° to 2,400° F range. Initial work involves the determination of short-time creep behavior of certain promising compositions in vacuum at 2,200° F. The effect of tantalum, tungsten, and molybdenum additions on creep of V-60Cb-1Ti is being determined. Reinvestigation of certain binary systems, notably V-Ta, is being carried out with the hope of formulating beneficial heat treatments for enhancement of high-temperature properties. Author

N64-20566 IIT Research Inst., Chicago, Ill. Technology Center
FRACTURE OF METALS Summary Report, 22 Mar. 1963-22 Mar. 1964
W. Rostoker 2 Apr. 1964 37 p refs
(Contract DA-11-ORD-022-3108)
(IITRI-B183-16; AD-435201)

Delayed failure occurs with high-strength metals wetted by certain embrittling liquid metals. Dispersion-strengthened and cold-worked metals are prone to delayed failure but soft, annealed metals are not. Cracking during the period of sustained loading can only be detected in the last few minutes before failure. A mechanism is proposed based on stress-accelerated intergranular penetration. Thus, failure time depends on both stress and temperature. Below a certain stress (endurance limit), temperature alone is inadequate, and failure does not occur. Certain preconditioning anneals retard and suppress delayed failure. A method is described for measuring the fracture energy of polycrystalline metals in the presence of a low-melting liquid metal. Author

N64-20572 Aerojet-General Corp., Azusa, Calif. Von Karman Center
STRESS-CORROSION CRACKING OF HIGH-STRENGTH ALLOYS Quarterly Report, 1 Jan.-31 Mar. 1964
R. B. Setterlund Apr. 1964 28 p
(Contract DA-04-495-ORD-3069)
(Rept.-0414-02-3; AD-437965)

This report on the current program status includes the following: (1) The compositional variations of nine heats of 18%-nickel maraging steel and the mechanical properties of the nine heats are listed. Fracture toughness results show a very definite relationship between critical crack growth and yield strength. (2) An environment containing distilled water was more severe for stress corrosion cracking of the steel than was an environment of distilled water containing 3% NaCl. The 18%-nickel maraging steel was more resistant to stress-corrosion cracking than the low-alloy or hot-worked die steel, when compared at the same strength level. (3) Temperature has a much greater effect on the failure time of 18%-nickel maraging steel than it has on the low-alloy or hot-worked die steel. (4) The measurement of the electrochemical changes occurring in 18%-nickel maraging steel during stress-corrosion exposure and the determination of the effect of applied potential on failure time show a potential shift toward the cathode as the stresses at the crack tip increase as a result of incremental loading. (5) The inhibited epoxy coating was more effective in preventing stress-corrosion cracking, under the test environmental conditions, than the polyurethane or inorganic zinc coating. I.v.L.

N64-20610* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
TENSILE PROPERTIES OF PYROLYTIC TUNGSTEN FROM 1370° TO 2980° IN VACUUM
J. L. Taylor and D. H. Boone Repr. from J. Less-Common Metals (Amsterdam), v. 6, 1964 p 157-164 refs
(NASA Contract NAS7-100)
(NASA CR-53992; JPL-TR-32-463)

The tensile properties of annealed pyrolytic tungsten were measured at a strain rate of 0.02/min from 1,370° to 2,080° C in vacuum. Data for powder metallurgy and plasma-flame single-crystal tungsten are shown for comparison. A few engineering stress-strain curves are given for pyrolytic and powder metallurgy tungsten. Although voids are present in the pyrolytic material after annealing, the voids that form and grow during testing have a more important detrimental effect on ductility. The "as deposited" anisotropy of the microstructure is maintained after recrystallization and enhances the tendency to void formation and growth. With the exception of one specimen containing no voids, as the result of a lower annealing temperature, pyrolytic tungsten has a lower ultimate strength than powder metallurgy tungsten in the temperature range studied. Author

N64-20687* Lockheed Missiles and Space Co., Sunnyvale, Calif.
ALUMINUM ALLOY 2319 WELD WIRE INVESTIGATION
M. V. Steen [1964] 14 p refs
(NASA Contract NAS8-5600)
(NASA CR-56100; LMSC/A650295; NSP-64-35) OTS: $1.60 ph

Defective welds were found in 2219 aluminum alloy. The cause of the inadequate weld quality was isolated and attributed to the 2319 aluminum welding wire. The weld wire imperfections were of two major types: surface pits and foreign particulate matter adhering to the wire. A comprehensive investigation revealed the foreign particulate matter to be the major cause of defective welds. The weld wire producer has improved the spooling techniques and modified the reel—the source of the foreign matter on the wire. Author

N64-20725* Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
DETERMINATION OF THE WELDABILITY AND ELEVATED TEMPERATURE STABILITY OF REFRACTORY METAL ALLOYS Second Quarterly Report, Sep. 21, 1963-Dec. 21, 1963
G. G. Lessmann and D. R. Stoner [1963] 52 p refs
(NASA Contract NAS3-2540)
(NASA CR-56136; WANL-PR-(P)-002) OTS: $5.60 ph

The purpose of this program is to determine the weldability and longtime elevated temperature stability of promising refractory metal alloys in order to determine those most suitable for use in advanced alkali-metal space electric power systems. The current program status is as follows: (1) Procurement requests have been processed for all alloys. These alloys are those of Nb, Ta, and W. (2) The welding-chamber-atmosphere monitoring system was completed and placed into regular operation. This system provides for monitoring by two different oxygen gages and one moisture gage. (3) Weld chamber tooling is being installed. (4) The electron beam welder has been modified by the addition of a liquid nitrogen trap to improve vacuum capability following initial testing. (5) The ultra-high-vacuum furnace is in the process of construction. (6) Welding studies were initiated by producing weld restraint bead-on-plate patch tests in sheet from five alloys (Ta-10W, D-43, Nb-752, SNb-291, and C-129Y) and a circular groove restraint weld test in Ta-10W plate. In addition, a weld joint

configuration evaluation was undertaken for the 3/8-in.-plate thickness. All welding tests were accompanied by continuous weld atmosphere monitoring. I.v.L.

19 MATERIALS, NONMETALLIC

Includes mechanical and physical properties of nonmetals (e.g., plastics). *For related information see*: 07 Chemistry; 17 Machine Elements and Processes; 18 Materials, Metallic; 33 Stresses and Loads; and 34 Structural Design.

N64-20040 General Dynamics/Fort Worth, Tex.
MATERIAL – SEALANT, SYNTHETIC ELASTOMER – EVALUATION OF MODIFIED EC-1610 TYPE
J. M. Warren 15 Apr. 1964 19 p
(Contract AF 33(657)-11214)
(FGT-3029; AD-437252)

Suitable specimens of modified EC-1610 and PR-9422 B1/2 were prepared and tested. A comparison of the more important properties obtained on the two sealants is as follows: (1) Both materials have approximately the same application time. However, the modified EC-1610 develops hardness considerably faster than PR-9422 B1/2. (2) Modified EC-1610 and PR-9422 B1/2 have about the same resistance to thermal rupture and thermal shock after soaking in jet reference fuel (JRF). (3) Comparison of thermal extrusion of the two sealants shows the modified EC-1610 to have less extrusion from the small tubes used in the test than the PR-9422 B1/2. (4) Both sealants show comparable losses of adhesion to substrates after immersion in a 2-layer media, JRF-salt water, at 140° F. In resistance to JRF alone at 140° F, the PR-9422 B1/2 appears to have the advantage over modified EC-1610. (5) Both sealants show good repairability, that is, freshly mixed sealant will adhere to old, fuel-soaked sealant. Author

N64-20041 General Dynamics/Fort Worth, Tex.
MATERIAL – ADHESIVES – STRUCTURAL – F-111 – SCREENING TESTS OF
J. P. Thomas 15 Apr. 1964 53 p
(Contract AF 33(657)-11214)
(FGT-3048; AD-437249)

The metal-to-metal adhesive AF-33 performed satisfactorily when tested in creep rupture and exposed to salt water spray and high humidity under simulated F-111 environment conditions. Six sandwich-type adhesives all passed 270° and 350° F laminate-to-aluminum creep rupture with the exception of FM98-LX-112 and Epon 52-125. Epon 52-125 showed lower total deformation and permanent set in beam creep at 270° and 350° F; however, AF-130 and Narmco 328 HT yielded higher pi-tension results at the respective test temperatures than did the remaining adhesives. All sandwich adhesives tested performed satisfactorily in salt water spray and high humidity resistance. In the high temperature beam creep test of AF-130, 328 HT, and FM98-LX-112, on raising the temperature from 420° to 490° F the majority of the beams failed just before or on reaching 490° F. Author

N64-20044 General Dynamics/Fort Worth, Tex.
FLIGHT CONTROL SYSTEM: INVESTIGATION OF BEARING RETENTION BY USE OF ADHESIVE OR SEALANTS –
I. K. Spiker 15 Apr. 1964 25 p
(Contract AF 33(657)-112114)
(FGT-3082; AD-437251)

This report discusses the results of tests conducted on installation of bearings using sealants or adhesives. Tests were conducted to determine: the effect on breakaway torque; resistance to vibration under load; time and temperature properties under axial load; resistance to water, JP-4 fuel, and ethylene glycol; and the maximum thrust to remove bearings after each of the preceding tests. Methods of cleaning the bearing outer race were also studied. Author

N64-20045 General Dynamics/Fort Worth, Tex.
MATERIAL – ADHESIVE – DYNABOND 132 – ADDITIONAL TESTING AND DISPOSITION OF SPECIMENS REMAINING FROM 420°F CREEP TEST (50-2895)
I. K. Spiker 15 Apr. 1964 17 p
(Contract AF 33(657)-11214)
(FGT-3093; AD-438781)

Sandwich panel structures of various material combinations for use in F-111 high-temperature areas are being considered by the structures and fuselage design groups as possible alternates to the bonded titanium structure. Material combinations are PH15-7Mo honeycomb core and skins, glass-reinforced plastic (GRP) honeycomb core and skins, and GRP honeycomb core and PH15-7Mo skins, all bonded with Dynabond 132 adhesive. Tests were conducted to determine: creep properties of these various materials at 325° F, high-temperature beam shear strength of these panels bonded with Dynabond 132, and resistance to environmental conditions. It is indicated that: (1) The creep results obtained are not conclusive because the stainless-steel skins were loaded very close to their yield point. (2) Dynabond 132 bonded sandwich panels will produce core shear failure of annealed and heat-treated (condition TH1050) 3-15 NP, PH15-7Mo honeycomb core at 420° F. At 500° F, core shear failure is produced in the annealed core, but not in the heat-treated core. (3) Exposure to salt spray and humidity for 30 days had no detrimental effect on the bond, and no penetration of salt or moisture was found in any of the interior cells of the sandwich panels. (Annealed stainless-steel skin-GRP core specimens, exposed to humidity, are an exception.) I.v.L.

N64-20046 General Dynamics/Fort Worth, Tex.
MATERIAL – ELECTRICAL POTTING – PRO-SEAL 777 – EVALUATION OF
H. P. Owen 15 Apr. 1964 4 p
(Contract AF 33(657)-11214)
(FTDM-2910; AD-437592)

Based on results, Pro-Seal 777, batch C-903, exhibited inferior adhesion to various materials and depolymerization at 300° F, and testing was discontinued. A tabular summary reports methods, conditions, and results, in detail, of 9 specific tests, including application and cure, work life, viscosity, nonvolatile content, shrinkage, effect of fluids, and adhesion. A.W.

N64-20052 General Dynamics/Fort Worth, Tex.
MATERIAL – SEALANT, SYNTHETIC ELASTOMER – EVALUATION OF SELECTED PROPERTIES OF PR-9422 AND EC-1610
J. M. Warren 15 Apr. 1964 15 p
(Contract AF 33(657)-11214)
(FTDM-3124; AD-437601)

Tests were conducted to determine the relative effects of jet reference fluid and Type III test fluid on modified EC-1610, EC-1610 B-6, PR-9422 B-1/2, and PR-9422 B-2 sealants. The sealant specimens immersed in the jet reference fluid sponged, on heating to 275° F, to a greater extent and lost more tensile elongation than like specimens immersed in Type III test fluid. I.v.L.

N64-20053 General Dynamics/Fort Worth, Tex.
MATERIALS: CHANNEL SEALANTS – FOR USE IN F-111 INTEGRAL FUEL TANKS – SCREENING TEST OF
15 Apr. 1964 8 p
(Contract AF 33(657)-11214)
(FTDM-3134; AD-437604)

Screening tests were made of four channel sealants under simulated F-111 environmental conditions. Two tanks, 0.750 in. × 7.25 in. × 12.7 in. were constructed. Tank No. 1 was injected with XS-1402303F channel sealant on one side and PR-37-8 channel sealant on the reverse side. Tank No. 2 was injected with Q-9-0048 on one side and a 50-50 mixture of Q-9-0048 and Q-9-0068 on the reverse side. Adhesion to the cover plates was limited with PR-37-8 and very poor with Q-9-0048 and the 50-50 mixture in the nonreinjected areas. Channel sealant XS-1402303F adhered to the cover plate. No fuel leaks were encountered in any phase with any of the four channel sealants. However, the XS-1402303F was least affected by the simulated F-111 environmental conditions. A.W.

N64-20057 General Dynamics/Fort Worth, Tex.
MATERIALS: SEALANTS AND COATINGS – FOR USE IN F-111 INTEGRAL FUEL TANKS – SMALL TANK SCREENING TEST OF
Gale F. Wood 15 Apr. 1964 9 p
(Contract AF 33(657)-11214)
(FTDM-3165; AD-437600)

Screening tests on a channel sealant, faying surface sealant, filleting sealant, and two corrosion-protection coatings were conducted by applying them in a small test tank and subjecting them to environmental conditions simulating those of the F-111 integral fuel tanks. Results show that the channel sealant (Q9-0048T) will not withstand F-111 environmental conditions. Corrosion protection coating Q94-003 discolored and softened to some extent, but it may be usable. All other specimens performed satisfactorily. A.W.

N64-20058 General Dynamics/Fort Worth, Tex.
MATERIALS: FILLET AND FAYING SURFACE TYPE SEALANTS FOR F-111 – SCREENING TEST OF –
Gale E. Wood 15 Apr. 1964 11 p
(Contract AF 33(657)-11214)
(FTDM-3169; AD-437954)

A faying surface sealant and a filleting sealant underwent screening tests by being subjected to environmental conditions, simulating those of the F-111 integral fuel tank. Neither sealant will withstand such conditions. A.W.

N64-20064 General Dynamics/Fort Worth, Tex.
MATERIALS: FILLETING AND FAYING SURFACE SEALANTS – FOR USE IN F-111 INTEGRAL FUEL TANKS – SCREENING TEST OF
Gale E. Wood 15 Apr. 1964 7 p
(Contract AF 33(657)-11214)
(FTDM-3210; AD-437593)

An improved one-part filleting sealant and two different two-part faying surface sealants were subjected to screening tests under conditions simulating the environment of the F-111 integral fuel tanks. New Q94-002 (one-part filleting sealant) performed satisfactorily in all tests except that it is 20.6% over the stipulated specific gravity maximum. Both Q94-503 and XS-1402340 (two-part faying surface sealants) exhibited poor adhesion and unsatisfactory thermal extrusion. It would appear that they are incapable of withstanding environmental conditions specified for F-111 integral fuel tank sealants. A.W.

N64-20071 General Dynamics/Fort Worth, Tex.
DEVELOPMENT IN THERMAL-STRUCTURAL COMPOSITES AT GENERAL DYNAMICS/FORT WORTH
M. S. Howeth, H. R. Thornton, and J. E. Burroughs 15 Apr. 1964 45 p Presented at the 8th ASD/NASA Sponsored Refractory Composite Working Group Meeting, Fort Worth, Tex., 14–16 Jan. 1964
(Contract AF 33(657)-11214)
(FZM-4037; AD-438471)

Efforts are concerned, generally, with the application of composite systems as structural components, cooling systems, and environmental control systems. Specifically, investigations are in the areas of attachments for ablation systems, oxidation-resistant coatings for refractory metals, foamed ceramic composites, plasma-arc sprayed coatings, and inorganic–organic material system development. Author

N64-20078 ARO, Inc., Arnold Air Force Station, Tenn.
EVALUATION OF MARK CRYOPANEL COATINGS
J. P. Dawson and B. A. Mc Collough Arnold Eng. Develop. Center, May 1964 34 p
(Contract AF 40(600)-1000)
(AEDC-TDR-64-85; AD-438403)

This study was conducted to evaluate a number of paints and surface coatings for use on the copper, 72° K-cryopanels in the aerospace environmental chamber, Mark I. The specific areas of investigation were (1) adhesive properties of the coatings under vacuum conditions and temperature cycling from 77° to 300° K, (2) outgassing characteristics of the various coatings, and (3) the reflectance of the coatings in the 0.35μ to 2.7μ. Data were also taken to determine the effect of cyropanel surface preparation on the adhesive properties of the coatings and paints under investigation. Results of the tests indicate that several of the coatings merit consideration for use on the Mark I cryopanels. Author

N64-20080 Great Lakes Research Corp., Elizabethton, Tenn.
RESEARCH ON PRESSURE BAKED GRAPHITE MATERIALS Quarterly Progress Report, 1 Jan. 1964–1 Apr. 1964
G. Stecker et al Apr. 1964 21 p
(Contract AF 33(657)-11738)
(AD-437661)

The investigation of the effects of formulation and other process variables on the properties of graphitized specimens produced in the isostatic pressure baking process was continued. It was shown that both high isostatic pressure surrounding the impermeable deformable envelope, and high gas pressure surrounding the specimen within the envelope during upheat are necessary for best results. Holding time at maximum differential pressure was found to be important at a process temperature of 590° C. The desirability of a slightly higher process temperature is indicated. Pitch binder coke yield was found to increase from 68% at atmospheric pressure to 85% at 1,800 psig gas pressure, when heated to 590° C in 2 hours, followed by atmospheric pressure baking to 1,000° C. The five carbonaceous flour aggregates used in this program have been characterized by a standardized measurement of coefficient of thermal expansion. Author

N64-20158 Union Carbide Corp., Tonawanda, N.Y. Linde Div.
RESEARCH ON RHEOLOGIC AND THERMODYNAMIC PROPERTIES OF SOLID AND SLUSH HYDROGEN Quarterly Report No. 3, 16 Dec. 1963–15 Mar. 1964
Gerhard A. Cook, Robert F. Dwyer, and Arthur C. Jenkins 24 Apr. 1964 39 p refs
(Contract AF 33(657)-11098)
(AD-437501)

The literature search included available information on the density of liquid parahydrogen and on the thermal conductivity of liquid and solid parahydrogen, and a review of methods for determining the concentration of orthohydrogen in hydrogen. The experimental work involved operation of the high-pressure, low-temperature calorimeter and results for the molar volume, the melting temperatures, and the heats of fusion of solid parahydrogen. Smoothed values are tabulated for the heat of fusion at integral pressures up to 400 atm and at integral temperatures up to 24° K. The heat of fusion of parahydrogen is a linear function of the pressure. Author

N64-20170 Union Carbide International Co., New York, N.Y. Union Carbide European Research Associates
RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. SUPPLEMENT TO VOLUME XI – CHARACTERIZATION OF BINDERS USED IN THE FABRICATION OF GRAPHITE BODIES
E. De Ruiter, J. F. M. Oth, V. Sandor, and H. Tschamler Mar. 1964 42 p refs
(Contract AF 33(616)-6915)
(WADD-TR-61-72, Vol. 11 Suppl.; AD-289848)

A typical coal tar pitch has been separated into fractions that have been analyzed and characterized by selected physical and chemical methods. These results have indicated the presence of molecules consisting of from one to several aromatic clusters, each having a mean cluster size near four aromatic rings. Information has been obtained on aromaticity, hydrogen distribution, and substitution index. A study has been made of the effect of temperature and different atmospheres on the plasticity of the various fractions of the pitch sample. Author

N64-20466 Princeton U., N.J. Frick Chemical Lab.
MEASUREMENT OF RANDOM SCISSION BY STRESS RELAXATION IN POLYSULFIDE AND OTHER NETWORKS: WEAK LINKAGES
Arthur V. Tobolsky Mar. 1964 8 p refs
(Contract Nonr-1858(07))
(ONR-TR-RLT-74; AD-432407)

Equations are presented for the measurement of random scission in polysulfides by stress relaxation. It is assumed that the network is more or less uniform containing a certain total number of cleavable bonds per chain and that a fraction of these bonds consists of weak linkages. The major relaxation process is a homolytic polysulfide interchange. The theoretical considerations discussed are also applicable to polyurethane networks prepared by crosslinking an isocyanate prepolymer with a triol. I.v.L.

N64-20467 Princeton U., N.J. Frick Chemical Lab.
EFFECT OF PLASTICIZATION ON THE VISCOELASTIC PROPERTIES OF POLYVINYL CHLORIDE
M. C. Shen and A. V. Tobolsky Apr. 1964 17 p refs
(Contract Nonr-1858(07))
(ONR-TR-RLT-76; AD-437259)

Modulus-temperature and modulus-time curves up to high temperatures were made for polyvinyl chloride and polyvinyl chloride plasticized with 30% dioctyl phthalate. Incorporation of stabilizer and rapid measurements minimized chemical decomposition and diluent evaporation. At temperatures above the melting point of PVC crystallites, flow regions are observed. The presence of plasticizer caused a lowering of T_m and of T_g. Below T_m, both pure PVC and plasticized PVC behave like semicrystalline polymers. The presence of diluents affects the viscoelastic properties below T_m mainly by changing T_g of the amorphous regions, without very significant changes in the microcrystalline structure. Above T_m, the relaxation times are definitely shortened because of the lower value of T_g. Author

N64-20488 Bureau of Mines, Norris, Tenn. Metallurgy Res. Lab.
SYNTHESIS AND PROPERTIES OF GERMANIUM FLUORPHLOGOPITE
John L. Miller, Jr., M. V. Denny, and H. R. Shell 1964 17 p refs
(BM-RI-6443)

A synthetic germanium fluorphlogopite was obtained by the isomorphic substitution of germanium for silicon in the synthetic silicon fluorphlogopite structure. The morphology of the germanium isomorph ($K_2Mg_6Al_2Ge_6O_{20}F_4$) is essentially the same as that of synthetic silicon fluorphlogopite. Monoclinic cell constants were determined from X-ray powder data, single-crystal precession photographs, and Laue transmission photographs. Author

N64-20495 United Kingdom Atomic Energy Authority, Harwell (Gt. Brit.) Research Group
RADIATION RESISTANT GLASSES
J. V. Best Nov. 1963 27 p refs
(AERE-R-3998) HMSO: 4s

Several stabilized optical glasses are described that have been developed to withstand radiation doses of 10^7r of γ-radiation. Radiation stability data are also given for various other transparent materials including plate glass, Perspex, and Polystyrene. With suitable glasses it should be possible to satisfy most of the requirements for stabilized optical instruments; plastic lenses can also be used in a number of cases where these are cheaper than lenses made from special glasses. High-density glasses for direct-viewing windows may be stabilized, but they are rather colored. Where several thick blocks are used, only the inner blocks near the source of radiation need be stabilized in order to save unnecessary light absorption. Author

N64-20521 Battelle Memorial Inst., Columbus, Ohio
PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING FEBRUARY, 1964
Russell W. Dayton and Ronald F. Dickerson 1 Mar. 1964 61 p refs
(Contract W-7405-ENG-92)
(BMI-1665(Del.)) OTS: $1.25

The current status of the following areas is discussed: (1) reactor materials and components; (2) reactor-fuel studies; (3) general fuel-element development; (4) radioisotope and radiation applications; (5) the development of a tracer system for in-place filter evaluation; (6) coated-particle fuel materials; (7) corrosion studies of the fluoride-volatility process; (8) the long-term creep-rupture program on sintered aluminum-powder alloys; (9) the mechanical properties of zirconium alloys; (10) fission-product deposition studies; (11) the gas-cooled reaction program (encapsulation studies); and (12) the joining of regenerative cell components. I.v.L.

N64-20541 Aerojet-General Corp., Sacramento, Calif. Solid Rocket Plant
DEVELOPMENT OF IMPROVED RESIN SYSTEMS FOR FILAMENT-WOUND STRUCTURES Fifth Bimonthly Progress Report, 11 Jan.-10 Mar. 1964

J. J. Cooney 12 Apr. 1964 52 p
(Contract NOw-63-0627-c)
(Rept. 0627-VI-5; AD-436856)

Presented are the results of statistical analyses of property data obtained for resin systems cured with ethylenediamine, hexamethylenediamine, and hexahydrophthalic anhydride, together with the analyses of data not previously reported for tests conducted on 4,4'-methylenediamine-cured systems. The results of property tests for systems cured with succinic anhydride, and polysebacic anhydride are also reported.
Author

N64-20605* Johns Hopkins U., Baltimore, Md. Dielectrics Lab.
INVESTIGATION OF THE BEHAVIOR OF DIELECTRIC MATERIALS AT HIGH FIELD STRENGTHS IN A HIGH VACUUM ENVIRONMENT Third Quarterly Progress Report, Oct. 1, 1963-Dec. 31, 1963
Louis J. Frisco 15 Jan. 1964 25 p
(NASA Contract NAS8-5253)
(NASA CR-56034; TR-9) OTS: $2.60 ph

The effects of a vacuum, X-ray irradiation, and temperature on the a.c. loss properties (ϵ' and tan δ) and the d.c. conductivity of various insulating materials, such as Mylar C, various polytetrafluoroethylenes and polystyrenes, are discussed. I.v.L.

N64-20632* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
SOME LOW-MODULUS BIREFRINGENT RESINS
A. San Miguel and E. N. Duran Repr. from Exp. Mech., Mar. 1964 6 p refs
(NASA Contract NAS7-100)
(NASA CR-56083; JPL-TR-32-556)

Information is given for preparation and selection of clear, bubble-free, constant-thickness, low-modulus (500 psi or less) birefringent resins. Various urethane formulations are examined. The effects of environment, mixing, casting, molds, cure, postcure, and calibration are discussed. A procedure to select a particular formulation is suggested.
Author

N64-20691 Alfred U., N.Y. Coll. of Ceramics
ELASTIC PROPERTIES OF MAGNESIA AND MAGNESIUM-ALUMINATE SPINEL Final Summary Report
D. H. Chung, G. R. Terwilliger, W. B. Crandall, and W. G. Lawrence 29 Feb. 1964 91 p refs
(Contract DA-31-124-ARO(D)-23)
(AD-432276) OTS: $8.60

CONTENTS:

PART ONE
1. ELASTIC PROPERTIES OF MAGNESIUM OXIDE p 1-57 refs (See N64-20692 13-19)

PART TWO
2. ELASTIC PROPERTIES OF POLYCRYSTALLINE MAGNESIUM—ALUMINATE SPINEL p 58-79 refs (See N64-20693 13-19)

N64-20692 Alfred U., N.Y. Coll. of Ceramics
ELASTIC PROPERTIES OF MAGNESIUM OXIDE
In its Elastic Properties of Magnesia and Magnesium-Aluminate Spinel 29 Feb. 1964 p 1-57 refs (See N64-20691 13-19) OTS: $8.60

The adiabatic technical elastic moduli $E_{[hkl]}$ and $G_{[hkl]}$ of single-crystals of magnesium oxide have been measured over a temperature range of 298° to about 1,600° K by a Förster-type resonance method. These data were compared with the low-temperature values (80° to 560° K) of the principal elastic constants c_{ij} and coefficients s_{ij} as reported by Durand. Significance of the present data is discussed with particular emphasis on the following points: (1) the elastic anisotropy in MgO single-crystals, (2) the temperature variation of the elastic modulus as a function of thermal expansion, (3) the temperature dependence of the elastic modulus described by the above expression for a wide range of temperature, (4) the expression giving a value of the elastic modulus at 0° K and (5) the possibility of using measurements on the elastic properties of a dense-formed polycrystalline material to obtain information, i.e., the Debye temperature, heretofore obtainable only from the corresponding single-crystal elasticity data.
Author

N64-20693 Alfred U., N.Y. Coll. of Ceramics
ELASTIC PROPERTIES OF POLYCRYSTALLINE MAGNESIUM-ALUMINATE SPINEL
In its Elastic Properties of Magnesia and Magnesium-Aluminate Spinel 29 Feb. 1964 p 58-79 refs Previously published as AROD-2891-7; See N63-18769 17-25 (See N64-20691 13-19) OTS: $8.60

Dense-formed specimens of magnesium-aluminate spinel with varying mole ratios of magnesia to alumina were prepared under controlled conditions. The room-temperature values of the elastic moduli were determined by means of a Förster-type resonance method for spinel compositions having 1:1, 1:2, 1:2.65, 1:3, and 1:3.5 mole ratios. Young's modulus as a function of temperature has been determined for the spinels having compositions of 1:1, 1:2.65, and 1:3.5 mole ratios of magnesia to alumina. The results are discussed with respect to the effects of porosity, composition, and temperature.
Author

N64-20709* Rensselaer Polytechnic Inst., Troy, N.Y.
[INTERDISCIPLINARY MATERIALS RESEARCH] Semi-Annual Progress Report No. 6, 1 Sep. 1963-29 Feb. 1964
S. S. Sternstein et al 23 Mar. 1964 19 p
(NASA Grant NsG-100-60)
(NASA CR-56129) OTS: $1.60 ph

The results of research efforts in the following areas are outlined: (1) polymer research, (2) a study of the interaction of dislocation with discrete second-phase particles in dispersion-strengthened alloys, (3) nucleation in liquid metals, (4) ultrasonic research, (5) ultrasonic pulse interferometry, (6) excited molecules, (7) mechanical properties of polymers, (8) high-temperature alloys, (9) low-temperature physics, (10) ceramics research, (11) charge-transfer complexes, (12) dispersion-strengthened materials, (13) corrosion studies, (14) nuclear magnetic resonance research, and (15) X-ray scattering.
R.T.K.

20 MATHEMATICS

Includes calculation methods and theory; computers; data processing; and numerical analysis. *For related information see*: 08 Communications; 09 Electronics; 10 Facilities, Research and Support; and 22 Navigation and Guidance.

N64-20002* Control Data Corp., Minneapolis, Minn. Research Div.
PLAN FOR STUDY OF COMPUTER REQUIREMENTS Monthly Progress Report, 1 Nov.-30 Nov. 1963

Joseph E. Carroll 4 Nov. 1963 17 p
(NASA Contract NAS1-2902)
(NASA CR-53630; CDC-TM-9552-6) OTS: $1.60 ph

Some areas of study of NASA computer requirements are presented. The navigation equation, whose solution is necessary to derive information from the scanning camera, will be studied for memory requirements, necessary subroutines, and computation speeds. The desirable features of a space computer to perform these operations will come under scrutiny, including such considerations as buffered input of camera data, instruction repertory, and types of storage. It is planned to study these areas in some detail, deriving design criteria, success probabilities, and flow chart sequences for implementing the scanning camera navigation concept. Author

N64-20006* Control Data Corp., Minneapolis, Minn. Research Div.
DESCRIPTION OF PROGRAM A (ABLE)
Bruce D. Vannelli 25 Sep. 1963 41 p refs
(NASA Contract NAS1-2902)
(NASA CR-53513; CDC-TM-9552-5) OTS: $4.60 ph

A FORTRAN-60 program was written for the Control Data Corporation-1604 computer, and was used as a first step in developing the complete simulation of an on-board data processor. A brief description is given of the program (ABLE), its use and its output. A flow chart for ABLE is included. R.T.K.

N64-20023 Brown U., Providence, R.I.
ON THE POSTULATE OF STABILITY OF MATERIAL IN THE MECHANICS OF CONTINUA
D. C. Drucker Nov. 1963 25 p refs
(Contract Nonr-562(20)/34)
(Tech. Rept. 34; AD-429286)

Some recent discussions of the postulate of stability of material, or its equivalent, were misleading in their implications of too great a physical generality. Others, on the contrary, have mistakenly attempted to show counter-examples to inevitable mathematical consequences (normality) of the postulate, resulting in a blurring of meaning and purpose. Therefore, the place of the postulates of stability in the small, and stability in the large, in the isothermal theory of mechanics of continua is described. Fully equivalent results are demonstrated for heterogeneous states of stress in a structure or any continuum, and for homogeneous states of stress either in homogeneous materials or in composite materials homogeneous on the macroscale. Examples are given to show that requiring too great a degree of stability leads to strong restrictions on physical behavior. Classification of statements of the postulate are made for reasonable application to time-independent and to time-dependent materials. Materials exhibiting changes of elastic moduli with plastic deformation, and materials undergoing large strain are treated briefly. Author

N64-20082 Michigan U., Ann Arbor Inst. of Sci. and Tech.
AN OPERATOR THEORETIC FORMULATION OF LINEAR DIFFERENTIAL SYSTEMS
W. A. Porter Apr. 1964 13 p refs
(Contract DA-36-039-SC-78801; Contract AF 33(657)-11501; NSF Contract GP-524; Proj. Michigan)
(Rept. 2900-458-R; AD-437802)

In this report the linear differential system $\dot{x}(t) = A(t)x(t) + B(t)u(t)$ $x(t_0) = x^0$ is reduced to a canonical operator theoretic form. This representation consists of a parameterized family of bounded linear transformations into a Cartesian product of the underlying scalar field. It gives immediate results for the minimum energy control problem. Author

N64-20108 Battelle Memorial Inst., Columbus, Ohio
PROGRAMMING LANGUAGE FOR AUTOMATIC CHECKOUT EQUIPMENT. VOLUME II: ADAPTED PLACE FOR THE BENDIX AN/GJQ-9
Burton H. Went Wright-Patterson AFB, Ohio, Oct. 1963 82 p
(Contract AF 33(657)-9157)
(RTD-TDR-4171, Vol. 2; AD-426308)

This report describes PLACE, a language for the programing of automatic checkout equipment, and tells how it can be used to write programs for the Bendix AN/GJQ-9, an automatic checkout machine controlled by a punched tape. The language is such that any program can be written for the AN/GJQ-9 without resorting to the use of actual machine language. Programing at the "machine language" level is done through the use of special statements involving mnemonic symbols and numeric values. In addition to the checkout-machine-controlling language, the programer is provided with language to control the compiler. With this language he can "define" new statements that may be in a PLACE-determined format, or as like the English language as he wishes to make them. The compiler-control language has facilities for writing arithmetic and Boolean expressions; logic decision tables; and "compile-time" subroutines, called forms, which may be called recursively. Author

N64-20160 System Development Corp., Santa Monica, Calif.
A SURVEY OF ALGOL-LIKE AND CONTEXT FREE LANGUAGE THEORY Scientific Report No. 8
Seymour Ginsburg 6 Mar. 1964 22 p refs For Presentation at the IFIP Working Conf. on "Formal Language Description Languages", Austria, 15–18 Sep. 1964
(Contract AF 19(628)-485)
(TM-738-006-00; AFCRL-64-283; AD-437325)

A survey is made of some of the theoretical (= mathematical and logical) results known about ALGOL-like or context free languages (abbreviated as languages). Among the various topics considered are the following: (1) the effect of various symbol manipulation operations upon languages; (2) the unsolvability of deciding for arbitrary languages L_1 and L_2 whether there is a machine mapping L_1 into L_2 in a non-trivial manner; (3) ambiguity; (4) simple automata and their role in developing language theory; and (5) the recognition problem, that is, the construction for a given language of a device that somehow decides if an arbitrary word belongs to the language. This problem is resolved by pushdown automata. Author

N64-20171 Battelle Memorial Inst., Columbus, Ohio
PROGRAMMING LANGUAGE FOR AUTOMATIC CHECKOUT EQUIPMENT. VOLUME I. ADAPTED PLACE FOR THE RCA DEE Technical Documentary Report, Jan. 1, 1963–Dec. 31, 1963
Burton H. Went Wright-Patterson AFB, Ohio, Res. and Technol. Div., Oct. 1963 95 p
(Contract AF 33(657)-9157)
(RTD-TDR-4171, Vol. 1; AD-426307)

This report describes PLACE, a language for the programing of automatic checkout equipment, and tells how it can be used to write programs for the RCA DEE, an automatic checkout machine controlled by a digital computer. The language is such that any program can be written for the DEE without resorting to the use of actual machine language. The stimulus and measurement equipment of the DEE can be programed at the "machine language" level through the use of special statements involving mnemonic symbols and numeric values. The controlling computer can be programed by the use of algebraic language statements, similar to those found in FORTRAN and ALGOL, or at the machine language level by

using special statements available for that purpose. In addition to the checkout-machine-controlling language, the programer is provided with language to control the compiler. The compiler-control language has facilities for writing arithmetic and Boolean expressions; logic decision tables; and "compile-time" subroutines, called forms, which may be called recursively. Author

N64-20269 Adaptronics, Inc., Alexandria, Va.
THEORY OF PROBABILITY STATE VARIABLE SYSTEMS. VOLUME II: HISTORICAL DISCUSSION OF PSV DEVICES WITH EMPHASIS ON THE NEUROTRON Technical Documentary Report, 15 Oct. 1961-14 Oct. 1962
(Contract AF 33(657)-7100)
(ASD-TDR-63-664, Vol. 2; AD-428099)

This volume traces the history and general background of probability state variable, (PSV) devices, and defines their distinguishing features. The Reron, Artron, and Neurotron represent a major portion of the field of PSV devices. Mention is given to another device, Halpern's Self-Organizing Binary Logical Network, which would also be classed as a PSV device; early related devices by Pierce, Kirsch, and Farley and Clark are noted. Most of these devices are able to learn logic functions, but the Neurotron combines logic with analog (gain-phase) functions, so that, in the Neurotron, logic, gain, and time constants are all subject to learning. Author

N64-20270 Weapons Research Establishment (Australia)
SOME ASPECTS OF THE DIGITAL SIMULATION OF A SURFACE-TO-AIR GUIDED MISSILE
L. A. Nicholls Jul. 1963 51 p refs
(SAD-126)

A basic problem in using a serial digital computer to solve the equations of a complex model of a surface-to-air guided missile is computing time, even with a fast digital computer such as the IBM 7090. However, this problem may be alleviated when the highest natural frequencies of the model are associated with linear transfer functions, by tailoring the appropriate integration method in the manner described by Anderson, Ball, and Voss, to represent the outputs of such transfer functions exactly at the sampling instants, for given inputs. Criteria were developed to determine the step length or sampling interval, with this method. For the numerical solution of the nonlinear differential equations of the model using a constant step length, very stable multistep integration methods due to Gurk were used satisfactorily. Kutta and Heun methods with derivative evaluations at equally spaced time intervals were tested for the solution of these nonlinear equations with poor results. Characteristic features of these different methods are discussed. Author

N64-20280 RAND Corp., Santa Monica, Calif.
AN ANALYTIC FORMULATION OF EQUATIONS OF STATE
D. J. Mc Closkey Feb. 1964 99 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3905-PR; AD-429196)

A general equation of state is presented that provides a suitable description of the thermodynamic behavior of metals over a very wide range of temperature and compression. The thermodynamic dependence of pressure and specific internal energy upon temperature and compression is described by equations having coefficients that can be related to measured or calculated physical variables. This makes such a formulation useful in assaying the effect of the parametric variation of the equation of state on hydrodynamic calculations. A description of the physical basis of the terms in the equation of state is given. The calculation of the specific entropy is reviewed, and a method of calculation of Hugoniot points is presented. A summary of the program that has been written for machine calculation of the equation of state is given, along with the appropriate input instructions. Author

N64-20299 Naval Ordnance Lab., White Oak, Md.
A FORTRAN III (IBM 7090) PROGRAM FOR THE CALCULATION OF THREE-SUBLATTICE MAGNETIZATIONS
G. Heiche Apr. 1964 30 p
(NOLTR-63-32; AD-434924)

For a given set of molecular field coefficients, the total and partial magnetizations as a function of temperature were calculated by an IBM-7090. It was assumed that the molecular field coefficients vary linearly with temperature. Up to 1,000 values can be calculated for each magnetization at equidistant temperatures. A complete listing of the subroutines and an example are included. Author

N64-20305 North Carolina State Coll., Raleigh School of Physical Sciences and Applied Mathematics
NUMERICAL TREATMENT OF AN INTEGRAL EQUATION ARISING IN A MIXED-BOUNDARY ELASTICITY PROBLEM
John T. Welch, Jr. 28 Apr. 1964 48 p refs
(Contract AFOSR-444-63)
(AD-437920)

A nonsingular Fredholm integral equation was solved numerically. The equation was derived by Sneddon and Collins in the analytical treatment of the stress field in a long cylinder containing a penny-shaped crack opened by an arbitrary axially symmetric pressure. In the discussion of the numerical treatment, emphasis was on techniques, which allow the treatment of additional cases, without excessive recomputation. Results are given for constant, parabolic, and step pressures across the crack, with variations in crack width and Poisson's ratio. The shape of the crack is also obtained in many cases. Author

N64-20332 Purdue U., Lafayette, Ind.
CHEMISTRY OF HOMOALLYLIC SYSTEMS Final Report, 1 Jul. 1961-31 Aug. 1963
Richard A. Sneen 14 Apr. 1964 8 p refs
(Grant DA-ARO(D)-31-124-63)
(AROD-2381-5; AD-438041)

The program status includes: (1) Crystalline β-napthalenesulfonate esters of cyclopropylcarbinol, of *cis*- and *trans*-2-phenylcyclopropylcarbinol and of cyclobutanol were synthesized. The rates of solvolysis of the three cyclopropylcarbinyl esters were determined in 90 volume percent aqueous dioxane 25° C. (2) The trifluoroacetate esters of *cis*- and *trans*-2-phenylcyclopropylcarbinol have been prepared, and their rates of solvolysis in 60 volume percent aqueous dioxane have been measured. (3) The 2,2-dideuterio-5,5-diphenylcyclopentanol and 2,2-diphenylcyclopentanol have been prepared and converted into their *p*-toluenesulfonate esters. (4) Both kinetic and stereochemical data of the solvolysis reactions of 2-octyl sulfonates, with and without added nucleophiles, have been collected. Solvent systems varied from pure methanol to pure water, and included mixtures of dioxane–water, dioxane–methanol, acetone–water, and acetone–methanol. (5) The reactions of several arylmethyl-chloroamines and hydroxylamines were studied under various reaction conditions. The reactions studied included carbon–nitrogen bond cleavage in glacial acetic acid. The N-chloro-N-benzylbenzhydrylamine underwent dehydrochlorination in dilute basic solutions at room temperature, forming benzhydrylidenebenzylamine in good yield. The reaction exhibited second-order kinetics, being first-order in base and first-order in chloroamine. I..L

N64-20336 Wisconsin U., Madison Mathematics Research Center
EXISTENCE AND STABILITY OF ALMOST PERIODIC SOLUTIONS OF DIFFERENTIAL EQUATIONS IN BANACH SPACES
C. T. Taam Mar. 1964 28 p refs Presented at the Am. Math. Soc. Meeting, Chicago, 24 Apr. 1964
(Contract DA-11-022-ORD-2059)
(MRC-455; AD-437291)

Conditions are obtained for certain nonlinear differential equations in a Banach space to possess a unique almost-periodic solution, which is positively asymptotically stable and negatively unstable. The treatment rests mainly on careful study of certain mappings between the space of almost-periodic functions and the space of generalized almost-periodic functions. Author

N64-20337 Wisconsin U., Madison Mathematics Research Center
ASYMPTOTIC FORMS OF DETECTORS OF SIGNALS IN NOISE
William L. Root Feb. 1964 39 p refs
(Contract DA-11-022-ORD-2059)
(MRC-456; AD-437292)

Two results in signal detection theory are derived and discussed. The first result is a precise statement and proof of an approximation, asymptotically correct as the observation interval becomes infinite, to what is usually called the optimum detector for sure signals in gaussian noise. The second result is the determination of a (presumably suboptimum) detector of noiselike signals in noise, which has the merit of minimizing asymptotically a certain bound on the errors from among a wide class of quadratic detectors, specified in a completely practical way. A theorem giving asymptotic expressions for the mean and variance of a class of estimators of power spectral density, of more or less standard type, is used and is proved. Author

N64-20338 Wisconsin U., Madison Mathematics Research Center
PROPERTIES OF SOLUTIONS OF QUASI-DIFFERENTIAL EQUATIONS
T. L. Sherman Mar. 1964 21 p refs
(Contract DA-11-022-ORD-2059)
(MRC-457; AD-437290)

The connection between quasi-differential equations, first introduced by D. Shin, and real canonical differential equations is discussed, and some basic oscillation properties are derived. Author

N64-20339 Wisconsin U., Madison Mathematics Research Center
ON THE PROBLEM OF WEAK MACH REFLECTION
Akira Sakurai Mar. 1964 39 p refs
(Contracts DA-11-022-ORD-2059; AF 49(638)-708)
(MRC-460; AD-437289)

To find a clue to the problem of the discrepancy in the weak Mach reflection, fundamental assumptions on which the three-shock theory by von Neumann was based were examined and were shown to become inadequate as the shock waves became weaker. The three shock theory was modified, giving the Mach shock angles consistent with the experimental values. For further study, an approach to utilize the flow field near the triple point is suggested and proves to give the angle; values agree well with the experimental data. Author

N64-20340 Wisconsin U., Madison Mathematics Research Center
ON APPROXIMATING EXTREMALS OF FUNCTIONALS. PART I: THE METHOD AND EXAMPLES FOR BOUNDARY VALUE PROBLEMS
Donald Greenspan Mar. 1964 32 p refs
(Contract DA-11-022-ORD-2059)
(MRC-466; AD-437288)

A new numerical method for a class of nonlinear boundary value problems is described, and a variety of examples are presented to indicate its potential value. The essential idea is to apply finite difference methods to a functional rather than to the Euler differential equation of that functional. Applications are made to problems in minimal surfaces, geodesics, and subsonic flows, which were previously inaccessible. Author

N64-20341 David Taylor Model Basin, Washington, D.C. Hydromechanics Lab.
NUMERICAL EVALUATION OF INTEGRALS CONTAINING MODIFIED BESSEL FUNCTIONS
W. L. Haberman and E. E. Harley Mar. 1964 15 p refs
(DTMB-1580; AD-436713)

Various infinite integrals containing modified Bessel functions were evaluated numerically on a high-speed computer. The results are presented in tabular form. Author

N64-20356 Naval Research Lab., Washington, D.C.
NABUR, A NAREC ASSEMBLER FOR THE BURROUGHS D825 MODULAR DATA-PROCESSING COMPUTER Narec Reference No. 30
Robert M. Mason and Irene G. Fishman 13 Jan. 1964 50 p refs
(NRL-5974; AD-420881)

NABUR, an assembly routine written for the Naval Research Electronic Computer (NAREC), produces object programs suited to the Burroughs D825 Modular Data-Processing Computer. The input data for this routine may consist of one or more punched tapes coded in a source language that augments D825 basic machine language. This report discusses conventions to be followed in writing source programs and general aspects of the routine itself. A numerical listing of Burroughs D825 instructions block diagrams of key subroutines, and a summary of NABUR rules appear as appendices. Author

N64-20377 Innsbruck U. (Austria)
APPLICATION OF SPINOR METHODS TO RIEMANNIAN MANIFOLDS Quarterly Technical Status Report No. 2, 1 Dec. 1963-29 Feb. 1964
F. Cap et al [1964] 8 p
(Contract 91-591-EUC-2947)
(AD-439076)

The problem of maintaining the spinor concept within the general theory of relativity, while extending it to cover the Lorentz case, is considered. Spin transformations in Riemannian space are discussed. R.T.K.

N64-20382 Army Signal Research and Development Labs., Fort Monmouth, N.J.
MODAL AND MANY-VALUED LOGICS
Erwin Biser Feb. 1964 57 p refs
(USAELRDL-TR-2435; AD-437998)

This report presents several postulate-sets and theorems for many-valued logics, logics characterized by more than two "truth-values." It also presents basic axiom-sets and theorems

for modal logics including that of strict implication. The matrix formulation of strict implication was utilized recently in the representation of neural nets. The report exhibits some of the paradoxes of strict implication and their analogues of material implication in the sentential calculus of A. N. Whitehead and B. A. Russell. The many-valued logics of J. Łukasiewicz, A. Tarski, and E. L. Post are treated in some detail. Finally, the report deals with the four-valued Post logic and the application of three-valued Post logic to switching and gate functions. Author

N64-20403 Massachusetts Inst. of Tech., Cambridge Operations Research Center

SCHEDULING INDEPENDENT TASKS ON ONE OR MORE PROCESSORS Interim Technical Report No. 2

Michael H. Rothkopf (Ph.D. Thesis) Jan. 1964 120 p refs (Contract Nonr-1841(87)) (AD-428857)

This thesis considers the problem of scheduling m independent, immediately available tasks on n processors. Each task, i, has a service time, T_i, and a waiting cost rate, $c_i(t)$, that is a function of time. There are no feasibility restrictions on the order in which the tasks are to be processed. The problem is related to the job shop scheduling problem and the problem of optimally assigning priorities in a queueing system. It is shown that when $c_i(t) = c_i e^{-rt}$ (i.e., linear waiting costs with continuous discounting at rate r) and there is a single processor, waiting costs are minimized by sequencing the tasks in decreasing $rc_i e^{-rT_i}/(1 - e^{-rT_i})$ order. A dynamic programing algorithm has been developed for a wide class of multiprocessor scheduling problems. Linear waiting costs (with or without discounting), arbitrary processor use costs, and certain other costs are considered. Several algorithms are presented for scheduling tasks with absolute deadlines on one or more processors. Author

N64-20415 Massachusetts Inst. of Tech., Cambridge

EXPANSION THEOREMS FOR SOLID SPHERICAL HARMONICS II

J. P. Dahl *In its* Solid State and Mol. Theory Group 15 Apr. 1964 p 47-50 refs (See N64-20412 13-25)

Expansion theorems for solid spherical harmonics dealing with expansions in inverse powers of the distance, encountered in multipole problems, are considered. The expansions derived are all particular cases of

$$\times \sum_{m=-n}^{n} C(n,n_1,N;m,M-m) Y_n^m(\theta_a,\phi_a) Y_{n_1}^{M-m}(\theta,\Phi).$$

R.T.K.

N64-20419 Naval Ordnance Lab., White Oak, Md.

THE GOURSAT PROBLEM FOR THE DIFFERENTIAL EQUATION $u_{xyz} = f$: A MIRAGE

Sherwood C. Chu and J. B. Diaz 2 Mar. 1964 13 p refs (NOLTR-64-38; AD-437155)

A typical boundary-value problem for the hyperbolic equation $u_{xy} = f(x,y,u,u_x,u_y)$ consists in prescribing the unknown function u(x,y) along two plane curves. Known as the Goursat problem, under suitable hypotheses, it theoretically always possesses a classical solution. By means of a simple example, the Goursat problem for the partial differential equation $u_{xyz} = f$ consists of prescribing the unknown function u(x,y,z) on three surfaces does not, in general, possess a classical solution. Author

N64-20423 France. Ministere de L'Air, Paris

THERMIC CONSTRAINTS [CONTRAINTES THERMIQUES] Scientific and Technical Publications, Technical Note No. 132

A. Brodeau Paris, Service de Documentation Sci. et Tech. de l'Armament, 1963 105 p refs in FRENCH

This report deals with: (1) the determination of thermal constraints according to the methods of the theory of elasticity; (2) generalities of thermal torsions; (3) the determination of constraints and deformations in solid and hollow spheres and cylinders for various cases of temperature distribution; (4) constraints and deformations in rectangular plates and nonuniform circular heating; (5) a rapid method for calculating the flatting force for solid and slender beams; (6) the effects of local heating on slender beams; and (7) a study of superficially heated solids. I.v.L.

N64-20430 California U., Livermore Lawrence Radiation Lab.

A COMPUTER CODE FOR THERMODYNAMIC ANALYSIS WITH APPLICATIONS TO TUNGSTEN AND RHENIUM VAPOR PLATING

G. E. Zima and R. J. Eckert 5 Feb. 1964 30 p refs (Contract W-7405-ENG-48) (UCRL-7667)

A computer program was devised for the free energy analysis of a fairly general class of reactions. The basic thermodynamic analysis was extended with two additional programs designed for the rough screening of single and simultaneous reactions for the vapor plating process. The comparison index used was the total initial pressure needed to yield a given quantity of metal under displacement to equilibrium conditions. Some tungsten and rhenium vapor plating reactions were analyzed by these techniques. Author

N64-20436 SAAB Aircraft Co., Linkoping (Sweden)

DESCRIBING FUNCTIONS AND TRANSFER CHARACTERISTICS FOR NONLINEAR ELEMENTS

Magnus Tideman Feb. 1964 17 p refs (SAAB-TN-51)

The functions f(u) and N(A) satisfy for positive u and A the equation

$$AN(A) = 4/\pi \int_0^{1/2\pi} f(A \sin t) \sin t \, dt.$$

The describing function N(A) is a useful tool in the analysis of control systems containing a nonlinear element with the relation $v = f(u)$, $f(u) = -f(-u)$ between input u and output v. For the generalized concepts, the (numerical) evaluation of the describing functions must be considered. A Monte Carlo method to be used on a digital computer is presented. The inverse problem, viz. that of computing the "transfer characteristics" f(u) to a given "describing function" N(A) is discussed. The mathematical problem consists of the solution of an integral equation of Abel's type from which an inversion formula can be derived. The numerical problem is more difficult, since the inversion formula is unsatisfactory for numerical work. It is necessary to restrict the possible N(A) in order to find good numerical methods. Author

N64-20451 Naval Ordnance Lab., White Oak, Md.

REMARKS ON A GENERALIZATION OF BANACH'S PRINCIPLE OF CONTRACTION MAPPINGS

Sherwood C. Chu and J. B. Diaz May 1964 15 p refs
(NOLTR-64-39; AD-437889)

A generalization of Banach's principle of contraction mappings appears in a book on fundamental analysis by Kolmogorov and Fomin. The purpose of this note is to show that this generalization is a special case of an elementary fact. Author

N64-20473 Argonne National Lab., Ill.
A METHOD OF CALCULATING TRANSIENT TEMPERATURES IN A MULTIREGION, AXISYMMETRIC, CYLINDRICAL CONFIGURATION. THE ARGUS PROGRAM, 1089/RE248, WRITTEN IN FORTRAN II
D. F. Schoeberle, J. Heestand, and L. B. Miller Nov. 1963 118 p refs
(Contract W-31-109-ENG-38)
(ANL-6654) OTS: $2.50

A detailed description is given of Argus, a FORTRAN II computer program for calculating transient temperatures in any concentric cylindrical configuration. Included are an explanation of the mathematical methods, a discussion of special features and restrictions, input and output descriptions, operating instructions, several sample problems, and the code listing. The program allows up to 25 concentric regions, each containing either a stationary or turbulently flowing material with temperature-dependent properties. Up to 100 node points per radial row and up to 16 radial rows are allowed. Material properties of flowing materials are approximated by second-order polynomials, and the thermal properties of stationary materials are constant within a temperature phase. Thermal resistances at stationary region interfaces are considered by means of input coefficients of heat transfer. Film coefficients on flowing region boundaries are calculated by the program, and time-dependent coolant velocities are permitted. Author

N64-20478 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
A STUDY OF OPTIMIZATION TECHNIQUES
Jerry L. Horsewood Jan. 1964 178 p refs
(SM-45811)

The analytic and numerical aspects of the application of three optimization techniques to a general problem in flight mechanics were investigated and compared. The three techniques included the calculus of variations, the method of steepest descent, and dynamic programing. A derivation of the theory of each technique was included to show where and why the major numerical difficulties arose. The procedures employed to overcome these difficulties are discussed in detail. The primary advantages afforded by each of the three techniques are also discussed and compared, and conclusions are drawn as to which technique will be best for a particular case. Author

N64-20484 California U., Berkeley
VECTOR-VALUED PERFORMANCE CRITERIA
A. Klinger [1963] 5 p refs
(NSF Grant 15965)

Briefly, system performance is measured by the m-vector $\underline{p}(\underline{x}) = (p_1(\underline{x}),\ldots,p_m(\underline{x}))$, $p_i(\underline{x}) = \underline{a}^i \cdot \underline{x}$ where $\underline{a}^i$ are constant vectors, and C, a closed bounded subset of E^n, is the constraint set to which the n-vector $\underline{x}$ that characterizes the system must belong. It has been stated that "the set Γ of all noninferior points on the boundary of C can be obtained by finding the optimal points in C with respect to weighted scalar-valued criteria $p(\underline{x};\ \underline{\mu}) = \mu_1 p_1(\underline{x}) + \ldots + \mu_m\ p_m(\underline{x})$, with the range μ_i ranging over nonnegative real numbers." It will be demonstrated in this report that the μ_i should actually range over strictly positive, rather than nonnegative, real numbers and that the above stated procedure may fail to yield "improper" noninferior points. (This report concerns correspondence from Professor L. A. Zadeh, which appeared in IEEE Transactions of Automatic Control, Vol. AC-8, No. 1, Jan. 1963.) I.v.L.

N64-20512 Stanford U., Calif. Computer Science Div.
NUMERICAL SOLUTION OF BOUNDARY-VALUE PROBLEMS BY THE METHOD OF INTEGRAL OPERATORS
Stefan Bergman and John G. Herriot 28 Feb. 1964 35 p refs
(Sponsored by NSF)
(CS-4)

Linear partial differential equations of the form

$$\tilde{L}(\tilde{U}) \equiv \tilde{U}_{xx} + \tilde{U}_{yy} + c\tilde{U} = 0 \quad c \neq 0 \qquad (1)$$

are considered in two real variables x and y where c is a real polynomial in x and y. The solution $\tilde{U}$ of the equation (1) is sought in a simply connected bounded domain D that assumes prescribed values on the boundary C of the domain D. The boundary C is assumed to be a closed curve, which is a sum of a finite number of analytic curve segments. It is also assumed that for this domain D, the differential equation (1) has no eigenvalues; this is ensured if, for example, c is negative throughout D. The method of the kernel function is used. R.T.K.

N64-20535 Michigan U., Ann Arbor Navigation and Control Systems Lab.
THE REPRESENTATION PROBLEM FOR A GENERAL LINEAR DYNAMIC SYSTEM Memorandum No. 2900-463-R
W. A. Porter and J. P. Williams May 1964 25 p refs
(Contract DA-36-039-SC-78801; Proj. Michigan)

This report defines a general linear system and shows that discrete, continuous, and discrete–continuous systems are expressions of the same mathematical structure. Author

N64-20538 Columbia U., New York, N.Y.
ON THE DISTRIBUTION OF THE SUPREMUM FOR STOCHASTIC PROCESSES WITH INTERCHANGEABLE INCREMENTS
Lajos Takács 30 Mar. 1964 27 p refs
(Contract Nonr-266(59))
(CU-42-64-NONR-266(59)MS; AD-436663)

It is shown that for a wide class of stochastic processes the distribution of $\sup_{0 \le u \le t} \xi(u)$ can be presented in a simple and elementary way by making use of only a generalization of the classical ballot theorem. Author

N64-20543 Columbia U., New York, N.Y.
THE USE OF A BALLOT THEOREM IN ORDER STATISTICS
Lajos Takács 24 Jan. 1964 10 p refs
(Contract Nonr-266(59))
(CU-39-64-NONR-266(33)MS; AD-436575)

The applications of the following generalizations of the classical ballot theorem in order statistics are considered: Let $\rho_1, \rho_2, \ldots, \rho_n$ be nonnegative, interchangeable random variables and $\tau_1, \tau_2, \ldots, \tau_n$ be the coordinates arranged in increasing order of n points distributed uniformly, and independently of each other in the interval (0,t). Define

$$\chi(u) = \sum_{\tau_r \le u} \chi_r$$

for $0 \leq u \leq t$. If $\{\chi_t\}$ and $\{\tau_t\}$ are independent sequences, then

$$P\{\chi(u) \leq u \text{ for } 0 \leq u \leq t | x(t) = y\} = \begin{cases} (1\frac{1}{t}) \text{ if } 0 \leq y \leq t. \\ 0 \text{ otherwise} \end{cases}$$

where the conditional probability is defined up to an equivalence.
R.T.K.

N64-20544 Columbia U., New York, N.Y.
AN APPLICATION OF A BALLOT THEOREM IN ORDER STATISTICS
Lajos Takács 27 Jan. 1964 6 p refs
(Contract Nonr-266(59))
(CU-40-64-NONR-266(33)MS; AD-436661)

By using two simple combinatorial theorems, an extension of the classical ballot theorem was obtained. Two examples for the application of this theorem in order statistics are presented. R.T.K.

N64-20545 Columbia U., New York, N.Y.
FROM BALLOT THEOREMS TO THE THEORY OF QUEUES
Lajos Takács 2 Mar. 1964 37 p refs
(Contract Nonr-266(59))
(CU-41-64-NONR-266(59)MS; AD-436662)

A single-server queue with Poisson input and general service times is considered and illustrates that all important problems concerning the queue size, the waiting time, and the busy period can be solved in an elementary way by using only two generalizations of the classical ballot theorem.
Author

N64-20551 European Organization for Nuclear Research, Geneva (Switzerland) Data Handling Div.
STATISTICS LECTURES II: MAXIMUM LIKELIHOOD AND LEAST SQUARES THEORY
Derek J. Hudson 8 Apr. 1964 116 p refs
(CERN-64-18)

The principle of maximum likelihood is introduced from the intuitive point of view of trying to find the most likely explanation of the experimental data observed. The graphs of several likelihood functions are sketched, most of them on a logarithmic scale. Bayes theorem shows how the likelihood function should be modified when prior information about the parameters is available. The section on least squares deals with the problem of fitting a polynomial to data pairs (x_i, y_i), where the $\{x_i\}$ are fixed in advance and the $\{y_i\}$ are random variables. Matrix algebra is used extensively to derive classical results, including the Gauss–Markoff theorem. Orthogonal polynomials are used both to simplify the analysis and to control rounding errors in the actual computations. The F test is used to help choose the degree of the polynomial to be fitted, when this is unknown. Author

N64-20613 American Society of Civil Engineers, New York, N.Y. Committee on Electronic Computation of the Structural Div.
SELECTED BIBLIOGRAPHY OF WORKS ON THE USE OF DIGITAL COMPUTERS IN STRUCTURAL ENGINEERING
Robert E. Fulton, John S. Archer, Heinrich W. Bergmann, John J. Kozak, and Charles H. Samson, Jr. 1 Apr. 1963 83 p refs

Contained in this bibliography are listings of papers and reports dealing with using computers in structural engineering, listings of books useful in computer work, and a listing of extensive bibliographies on numerical methods and associated topics. Papers dealing with analog computers, linear programing, and operations research are not included. I.v.L.

N64-20685* International Business Machines Corp., Bethesda, Md.
THE METHOD OF ADJOINTS AS APPLIED TO DETERMINISTIC LINEARIZED SYSTEMS Systems Analysis and Evaluation Technical Note No. 9
Martin Rush 11 Dec. 1963 9 p refs
(NASA Contract NAS5-3486)
(NASA CR-56098) OTS: $1.10 ph

This note presents an analytical development of the adjoint method as applied to linear deterministic systems. The development utilizes matrix notation as much as possible to simplify the development. The note also includes a simple example of the method to outline the computational steps required. Author

N64-20701 Cornell U., Ithaca, N.Y. Sibley School of Mechanical Engineering
WEIBULL TABLES FOR BIO-ASSAYING AND FATIGUE TESTING Technical Report No. 8
Henry P. Goode and John H. K. Koa Sep. 1962 53 p refs
(Contract Nonr-401(43))
(AD-286035)

This report presents an acceptance sampling procedure and tables of related sampling inspection plans for the evaluation of lot quality in terms of reliable life (or its complement, quantile life). The Weibull distribution (including the exponential distribution as a special case of the Weibull) is assumed as a statistical model for item lifelength. The evaluation of sample items is by attributes with life testing being truncated at the end of a specified period of time. Tables of factors are also provided from which other sampling inspection plans of desired form can be designed and for use in evaluating the operating characteristics of other specified sampling inspection plans in terms of item reliable life.
Author

21 METEOROLOGY

Includes climatology; weather forecasting; and lower atmosphere studies. *For related information see*: 05 Astronomy and Astrophysics; 12 Geophysics; and 29 Space Sciences.

N64-20011 Weapons Research Establishment (Australia)
THE VARIABILITY OF WIND MEASUREMENTS WITH SPACE AND TIME
Bryan Rofe Jan. 1964 58 p refs
(WRE-TN-PAD-80)

This note provides information on the space and time variability of the major atmospheric parameters, pressure, temperature, density, and wind. The variability of wind is discussed; a review of the work undertaken by other experimenters is presented. An estimate is given of the accuracy with which wind measurements may be applied to missile trials. Author

N64-20089 Liege U., (Belgium) Inst. d'Astrophysique
RESULTS OF OBSERVATIONS ON ATMOSPHERIC OZONE BY THE INFRARED METHOD, DEDUCED FROM DATA OBTAINED IN AROSA (SWITZERLAND) Technical Note No. 2
E. Vigroux and A. Debaix 31 May 1963 29 p refs
(Contract AF 61(514)-962)
(AFCRL-64-89; AD-439212)

The infrared method is based on the knowledge of 3 data on the atmospheric ozone—the total ozone, the absorption, and the

emission in the 9.6μ band. The values of the total ozone content were supplied by the Meteorological Observatory at Arosa. The data on the absorption and emission in the 9.6μ band were obtained with a single-pass Perkin–Elmer spectrometer. The laboratory was a room whose balcony was used to put the coelostat and mirrors. Mirrors, exterior or interior, form the image of either the sun for absorption, or a fixed region of the sky or a black body for emission on the entrance slit of the spectrometer. The radiations are dispersed by a prism of NaCl and, as the spectrum passes on the exit slit, a thermocouple detects the energy coming out of this slit. During the observations, the absorption in the 1.13μ water vapor band for deducing the mass of water vapor at the zenith was recorded.

Author

N64-20092 Norwegian Meteorological Inst., Blindern
STATISTICAL – DYNAMICAL METEOROLOGICAL PREDICTIONS Summary Report
R. Fjørtoft and J. Nordø 20 Jan. 1964 45 p refs
(Contract AF 61(052)-374)
(AFCRL-64-334; AD-437950)

The main results obtained in a research project on general circulation are summarized. The level of energy balance in the atmosphere, on a hemispheric scale, was investigated. This research also includes an attempt to determine the degree of coupling between different relevant atmospheric parameters. Computations were carried out to give a space-scale decomposition of the z_0, h, and z_5 fields(z_0 and z_5 denote the heights of the 1000-mb and 500-mb surfaces, and h denotes the thickness computed from $h = z_5 - z_0$). R.T.K.

N64-20150 Miami U., Coral Gables, Fla. Inst. of Marine Science
MESOSCALE STUDIES OF INSTABILITY PATTERNS AND WINDS IN THE TROPICS First Semi-Annual Report, 1 May-30 Nov. 1963
Harold P. Gerrish and Homer W. Hiser Dec. 1963 79 p refs
(Contract DA-36-039-SC-89111)
(Rept. 4; AD-435890)

Case studies were used to compare echo motions derived from conventional PPI and CAPPI data, respectively, with winds aloft. Brief surveys were made on the trackable lifetime of echoes and the relation of low-cloud patterns to mesoscale features. A climatic rainfall study of South and South-Central Florida is presented with isohyetal analysis based on data from 80 stations. Finally, a comparison was made of concurrent pibal and rawin observations for Merida, Mexico. Aside from problems of continuity associated with manual data collection and typically small displacements of tropical echoes, results of echo motions using CAPPI data were encouraging enough to warrant additional study. Author

N64-20164 McGill U., Montreal (Canada) Arctic Meteorology Research Group
EVAPORATION AND SENSIBLE HEAT FLUX OVER THE ARCTIC OCEAN Scientific Report No. 10
E. Vowinckel and Bea Taylor Mar. 1964 44 p refs
(Contract AF 19(604)-7415)
(AFCRL-64-272; AD-438970)

Apart from long wave radiation, evaporation and sensible heat flux are the only means of transporting energy from the surface into the atmosphere. No method exists of measuring and observing evaporation and sensible heat flux directly. These fluxes have been calculated for each month over the Polar Ocean and the Norwegian–Barents Sea. Sverdrup's evaporation formula was used, and with it the effect of the Arctic wind conditions could be taken into account. Seasonal maps were constructed of mean wind speed. Evaporation and sensible heat flux were calculated separately for the following areas: Central Polar Ocean, Kara-Laptev Sea, East Siberian Sea, Beaufort Sea, and belts of 5° latitude of the Norwegian–Barents Sea. Author

N64-20166 RAND Corp., Santa Monica, Calif.
FORBIDDEN REGIONS FOR THE FORMATION OF CLOUDS IN A PLANETARY ATMOSPHERE
G. F. Schilling Apr. 1964 18 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4084-PR; AD-438216)

Every model planetary atmosphere implicitly establishes unique altitude distributions for the saturation vapor pressures of its minor constituents solely by relating ambient atmospheric pressures and temperatures to altitude. It is therefore possible to determine for any model atmosphere those altitude regions where cloud formation due to condensation or sublimation of minor constituents is permitted or forbidden by basic thermodynamic laws, regardless of the amounts of the minor constituents present. As an example, this exclusion principle is applied to the formation of H_2O clouds in the earth's upper atmosphere for conditions given by supplemental model atmospheres for latitudes 15° to 75°. The specific results presented permit inferences with regard to the expected seasonal distribution of noctilucent clouds and serve generally to illustrate the application of a basic principle of thermodynamics to the study of planetary atmospheres. Author

N64-20201 Joint Publications Research Service, Washington, D.C.
TURBULENT DIFFUSION IN THE SURFACE LAYER OF THE EARTH'S ATMOSPHERE
6 May 1964 321 p refs Transl. into ENGLISH of Tr. Leningr. Gidrometeorol. Inst. (Leningrad), no. 15, 1963 p 1–240 (JPRS-24490; OTS-64-31213) OTS: $5.00

CONTENTS:

PART I: THEORETICAL WORK

1. DIFFUSION OF FOREIGN MATTER FROM POINT SOURCES IN THE SURFACE LAYER OF THE ATMOSPHERE D. L. Laykhtman p 1–10 refs (See N64-20202 13-21)

2. DIFFUSION OF FOREIGN BODIES FROM A HIGH SOURCE G. Kh. Tseymin p 11–39 refs (See N64-20203 13-21)

3. CALCULATION OF ANNUAL AVERAGE CONCENTRATION OF ADMIXTURE AND METEOROLOGICAL FOUNDATION OF THE SELECTION OF THE HEIGHT OF FACTORY CHIMNEYS D. L. Laykhtman and S. N. Kaplan p 40–46 refs

4. PRINCIPLES OF TAKING INTO ACCOUNT METEOROLOGICAL CONDITIONS IN PLANNING INDUSTRIAL ENTERPRISES D. L. Laykhtman, F. A. Gisina, and S. N. Kaplan p 47–59

5. THE PROBLEM OF DISTRIBUTION OF A HEAVY HOMOGENEOUS ADMIXTURE FROM A HIGH SOURCE L. R. Arrago and M. Ye. Shvets p 60–66 refs (See N64-20204 13-21)

6. DETERMINING THE COEFFICIENT OF TURBULENCE IN THE BOUNDARY LAYER OF THE ATMOSPHERE M. I. Ruzin p 67–85 refs (See N64-20205 13-21)

7. SOME RESULTS OF CALCULATION OF THE COEFFICIENT OF TURBULENT EXCHANGE IN THE BOUNDARY LAYER M. I. Ruzin, N. A. Boldyreva, and T. A. Savel'yeva p 86–105 refs (See N64-20206 13-21)

8. EFFECT OF BREEZES ON THE DIFFUSION OF PASSIVE CONTAMINATION FROM A CONTINUALLY ACTING SOURCE G. Kh. Tseytin p 106–125 refs (See N64-20207 13-21)

9. TIME OF ESTABLISHMENT OF STATIONARY DISTRIBUTION OF CONCENTRATION FROM A POINT SOURCE D. L. Laykhtman and E. K. Byutner p 126–132 refs (See N64-20208 13-21)

10. EFFECTIVE COEFFICIENT OF CAPTURE OF AEROSOL PARTICLES BY RAIN AND CLOUD DROPLETS E. K. Byutner and F. A. Gisina p 133–151 refs (See N64-20209 13-21)

11. DIFFUSION OF AN ADMIXTURE IN THE ATMOSPHERE IN PRESENCE OF CLOUDS AND PRECIPITATION F. A. Gisina p 152–167 (See N64-20210 13-21)

12. DISPERSION OF PASSIVE PARTICLES FROM A POINT SOURCE IN A HETEROGENEOUS MEDIUM E. K. Byutner and D. L. Laykhtman p 169–176 refs (See N64-20211 13-21)

PART II: EQUIPMENT AND EXPERIMENTAL WORK

13. STATIONARY PHOTOELECTRONIC ANEMOGRADIENTOGRAPH WITH AUTOMATIC NUMERICAL AVERAGING OF THE RESULTS OF MEASUREMENT L. G. Kachurin, B. Ya. Tolstobrov, and N. S. Yalynychev p 177–186 refs (See N64-20212 13-21)

14. DEVICE FOR THE SHAPING OF SQUARE PULSES FROM ELECTRIC SIGNALS OF ARBITRARY FORM OF SUBSONIC FREQUENCIES I. I. Prudovskiy and N. S. Yalynychev p 187–192 refs (See N64-20213 13-09)

15. REMOTE-CONTROLLED CUP ANEMOMETER WITH HIGH-FREQUENCY DATA UNIT A. I. Merzheyevskiy p 193–196 (See N64-20214 13-15)

16. DEVICE FOR THE AUTOMATIC RECORDING OF THE VERTICAL PROFILE OF THE WIND B. Ya. Tolstobrov p 197–205 refs (See N64-20215 13-15)

17. A STATIONARY AUTOMATICALLY BALANCING RECORDING TEMPERATURE GRADIENT METER L. G. Kachurin, B. Ya. Tolstobrov, V. M. Ushakov, and N. S. Yalynychev p 206–219 refs (See N64-20216 13-15)

18. AN UNBALANCED AUTOMATIC TEMPERATURE GRADIENT METER FOR FIELD USE L. G. Kachurin, B. Ya. Tolstobrov, V. M. Ushakov, and N. S. Yalynychev p 220–231 ref (See N64-20217 13-15)

19. AN AUTOMATICALLY RECORDING DIFFERENTIAL BALANCE METER B. Ya. Tolstobrov p 232–241 refs (See N64-20218 13-15)

20. AUTOMATIC INTEGRAL FLUCTUATION METERS L. G. Kachurin p 242–246 (See N64-20219 13-15)

21. ELECTRONIC ANEMO-FLUCTUATION METER M. L. Gol'denberg p 247–253 (See N64-20220 13-15)

22. A SEMICONDUCTOR VARIANT OF THE INTEGRAL FLUCTUATION METER S. M. Gershteyn p 254–258 (See N64-20221 13-09)

23. INERTIA CHARACTERISTICS OF AIR CURRENT DIRECTION SENSORS L. G. Kachurin and Ya. P. Popov p 259–269 refs (See N64-20222 13-15)

24. AERODYNAMIC INVESTIGATIONS OF THE PARAMETERS OF AIR FLOW DIRECTION SENSORS O. S. Obolenskiy p 270–278 (See N64-20223 13-02)

25. STANDARD DESIGN OF A LOW-INERTIA HOT-WIRE RESISTANCE ANEMOMETER WITH TEMPERATURE COMPENSATION L. G. Kachurin and Li Sang Keng p 279–288 refs (See N64-20224 13-15)

26. A FIELD AUTOMATICALLY BALANCING RECORDING TEMPERATURE GRADIENT METER B. Ya. Tolstobrov p 289–296 refs (See N64-20225 13-15)

27. COMPARISON OF THE CHARACTERISTICS OF ATMOSPHERIC TURBULENCE OBTAINED USING THE AUTOMATIC INTEGRAL FLUCTUATION METER (AIP) AND THE METHOD OF INSTANTANEOUS SMOKE PUFFS P. M. Mushenko p 297–301 refs (See N64-20226 13-21)

28. EXPERIMENTAL INVESTIGATION OF THE DISPERSION OF IMPURITIES FROM INSTANTANEOUS SOURCES P. M. Mushenko p 302–316 refs (See N64-20227 13-21)

N64-20202 Joint Publications Research Service, Washington, D.C.

DIFFUSION OF FOREIGN MATTER FROM POINT SOURCES IN THE SURFACE LAYER OF THE ATMOSPHERE

D. L. Laykhtman *In its* Turbulent Diffusion in the Surface Layer of the Earth's Atmosphere 6 May 1964 p 1–10 refs (See N64-20201 13-21) OTS: $5.00

A method for describing diffusion is discussed taking into account the peculiarities of the process of diffusion near the surface of the earth. Consideration is given to the diffusion of an admixture originating from a point source, with an axis ox in the direction of the wind, an axis oy perpendicular to the direction of the wind, and an axis oz upward. This method seeks the concentration of the diffusing admixture. C.L.W.

N64-20203 Joint Publications Research Service, Washington, D.C.

DIFFUSION OF FOREIGN BODIES FROM A HIGH SOURCE

G. Kh. Tseymin *In its* Turbulent Diffusion in the Surface Layer of the Earth's Atmosphere 6 May 1964 p 11–39 refs (See N64-20201 13-21) OTS: $5.00

A study is directed toward the resolution of problems of the stationary diffusion of a passive admixture emitting from a continuous point source, with relatively general assumptions concerning wind velocity and the coefficient of vertical turbulent diffusion. The first part of the study presents the general solution of the problem, on the basis of which several important examples are obtained. Calculating formulas are also derived in the first part of the study. The second part of the study is devoted to development of the method of calculating the concentration of the admixture. C.L.W.

N64-20204 Joint Publications Research Service, Washington, D.C.

THE PROBLEM OF DISTRIBUTION OF A HEAVY HOMOGENEOUS ADMIXTURE FROM A HIGH SOURCE

L. R. Arrago and M. Ye. Shvets *In its* Turbulent Diffusion in the Surface Layer of the Earth's Atmosphere 6 May 1964 p 60–66 refs (See N64-20201 13-21) OTS: $5.00

A study is presented of the solution of equations describing the turbulent diffusion of an admixture dispersing in the atmosphere from a continuously acting point source. Considered in the study is the further development of the polyempirical theory of turbulent diffusion. One of the phases of further development of this theory is connected with the development of methods of calculation of the admixture concentration for any given type of coefficient of vertical exchange and wind velocity. A method is based on the solution of the equation of the polyempirical theory of turbulent diffusion at finite differences. C.L.W.

N64-20205 Joint Publications Research Service, Washington, D.C.

DETERMINING THE COEFFICIENT OF TURBULENCE IN THE BOUNDARY LAYER OF THE ATMOSPHERE

M. I. Ruzin *In its* Turbulent Diffusion in the Surface Layer of the Earth's Atmosphere 6 May 1964 p 67–85 refs (See N64-20201 13-21) OTS: $5.00

This article is devoted to the description of several new methods for calculating the coefficient of turbulence, and to an analysis of several known methods for determining the coefficient of turbulence for any given level in the boundary layer of the atmosphere. All the methods for calculating the coefficient of turbulence are broken into four basic groups: (1) those based on calculation of the coefficient according to data on the wind and the field of pressure pertaining to the given level for which the coefficient is determined; (2) those based on calculation of the coefficient according to data on the underlying levels; (3) those based on calculation of the coefficient according to data on the overlying levels; and (4) those based on simultaneous calculation of data for both the underlying and the overlying levels. C.L.W.

N64-20206 Joint Publications Research Service, Washington, D.C.

SOME RESULTS OF CALCULATION OF THE COEFFICIENT OF TURBULENT EXCHANGE IN THE BOUNDARY LAYER

M. I. Ruzin, N. A. Boldyreva, and T. A. Savel'yeva *In its* Turbulent Diffusion in the Surface Layer of the Earth's Atmosphere 6 May 1964 p 86–105 refs (See N64-20201 13-21) OTS: $5.00

Results of calculation of the coefficient of turbulence in the boundary layer are discussed and analyzed. These calculations were performed for the purpose of determining the vertical profile of the coefficient at various level conditions of temperature stratification of the atmosphere. Formulas are given by which the calculations were performed. These formulas were derived from equations of turbulent motion of the atmosphere. The materials utilized and the method of calculation are covered, and an analysis of the computation results is given. C.L.W.

N64-20207 Joint Publications Research Service, Washington, D.C.

EFFECT OF BREEZES ON THE DIFFUSION OF PASSIVE CONTAMINATION FROM A CONTINUALLY ACTING SOURCE

G. Kh. Tseytin *In its* Turbulent Diffusion in the Surface Layer of the Earth's Atmosphere 6 May 1964 p 106–125 refs (See N64-20201 13-21) OTS: $5.00

A theoretical analysis is given of the effect of breeze circulation on the character of the distribution of passive admixtures emitting from a continuously acting point source. On the basis of physical considerations of the diffusion of an admixture in the atmosphere, the presence of breeze circulation must lead to a certain increase in concentration of pollution near the surface, due to a decrease in concentration at higher altitudes, where the breeze phenomenon is slight. With concrete calculations, the effect of this breeze extends a certain distance from the source. The solution described is simplified and schematized, and reflects the character of the effect of breeze circulation on the diffusion of the admixture with sufficient accuracy. C.L.W.

N64-20208 Joint Publications Research Service, Washington, D.C.

TIME OF ESTABLISHMENT OF STATIONARY DISTRIBUTION OF CONCENTRATION FROM A POINT SOURCE

D. L. Laykhtman and E. K. Byutner *In its* Turbulent Diffusion in the Surface Layer of the Earth's Atmosphere 6 May 1964 p 126–132 refs (See N64-20201 13-21) OTS: $5.00

Spatial distribution of concentration from a continuously acting point source is discussed. This work is aimed at the evaluation of the values t and ω; ω is the time of action of a continuous source, and t is a finite interval that separates the moment of measurement from the moment of commencement of action of the point source. Using a model of a continuous source as a combination of momentary sources, the evaluation is performed in the simplest case, in which the wind velocity and the coefficient of turbulence are constant. C.L.W.

N64-20209 Joint Publications Research Service, Washington, D.C.

EFFECTIVE COEFFICIENT OF CAPTURE OF AEROSOL PARTICLES BY RAIN AND CLOUD DROPLETS

E. K. Byutner and F. A. Gisina *In its* Turbulent Diffusion in the Surface Layer of the Earth's Atmosphere 6 May 1964 p 133–151 refs (See N64-20201 13-21) OTS: $5.00

Numerical evaluation is performed of the coefficients of capture of ash particles by cloud and rain droplets influenced by various mechanisms of capture. The effective coefficient of capture is computed for a given distribution of sizes of aerosol particles and water droplets. Different mechanisms of capture by clouds or rain predominate in different ranges of size of ash particles. The predominating capture of ash particles with radii ranging from 10^{-7} to $5 \cdot 10^{-5}$ cm is that due to electrostatic interaction of the particles and cloud droplets. For ash particles with radii ranging from $5 \cdot 10^{-6}$ to $2 \cdot 10^{-5}$ cm, capture is due mainly to electrostatic and polarization mechanisms, and for particles with radii ranging from $5 \cdot 10^{-5}$ to $2 \cdot 10^{-4}$ cm, capture is dominated by the polarization effect. C.L.W.

N64-20210 Joint Publications Research Service, Washington, D.C.

DIFFUSION OF AN ADMIXTURE IN THE ATMOSPHERE IN PRESENCE OF CLOUDS AND PRECIPITATION

F. A. Gisina *In its* Turbulent Diffusion in the Surface Layer of the Earth's Atmosphere 6 May 1964 p 152–167 (See N64-20201 13-21) OTS: $5.00

Described is the investigation of the diffusion of an admixture in the atmosphere with clouds and precipitation. The presence of clouds or precipitation led to a marked change in the diffusion of an admixture, particularly with increasing distance from the source. The concentration at the surface of the earth and the area of the zone of pollution decrease in the presence of precipitation, while at a given τ, i.e., with given intensity of rain (or a given form of cloud and humidity), the decrease of χ is greater with lower wind velocity. In the presence of precipitation the point at which ground surface concentration attains a maximum value approaches the source. Author

N64-20211 Joint Publications Research Service, Washington, D.C.

DISPERSION OF PASSIVE PARTICLES FROM A POINT SOURCE IN A HETEROGENEOUS MEDIUM

E. K. Byutner and D. L. Laykhtman *In its* Turbulent Diffusion in the Surface Layer of the Earth's Atmosphere 6 May 1964 p 169–176 refs (See N64-20201 13-21) OTS: $5.00

The function $\overline{v^2}(x, z)$ is treated within the framework of a system of structure of the surface layer of the atmosphere. Finding this function is necessary for a full description of the process of diffusion in the passive admixture in the surface layer of the atmosphere. The study is limited to finding the function $\overline{v^2}$ for the dispersion of particles from a continuously acting point source at altitude h. C.L.W.

N64-20212 Joint Publications Research Service, Washington, D.C.

STATIONARY PHOTOELECTRONIC ANEMOGRADIENTOGRAPH WITH AUTOMATIC NUMERICAL AVERAGING OF THE RESULTS OF MEASUREMENT

L. G. Kachurin, B. Ya. Tolstobrov, and N. S. Yalynychev *In its* Turbulent Diffusion in the Surface Layer of the Earth's Atmosphere 6 May 1964 p 177–186 refs (See N64-20201 13-21) OTS: $5.00

A description is given of one of two basic variants of a stationary photoelectronic anemogradientograph. This instrument is intended for the automatic determination of the profile of wind speed to altitudes of several hundred meters under stationary conditions. The second variant of the instrument discussed in this article uses an electronic scaling circuit, differing from the first variant that uses a mechanical reductor. C.L.W.

N64-20226 Joint Publications Research Service, Washington, D.C.

COMPARISON OF THE CHARACTERISTICS OF ATMOSPHERIC TURBULENCE OBTAINED USING THE AUTOMATIC INTEGRAL FLUCTUATION METER (AIP) AND THE METHOD OF INSTANTANEOUS SMOKE PUFFS

P. M. Mushenko *In its* Turbulent Diffusion in the Surface Layer of the Earth's Atmosphere 6 May 1964 p 297–301 refs (See N64-20201 13-21) OTS: $5.00

A direct relationship was established between the characteristics of scattering from instantaneous sources and the readings of the automatic integral fluctuation meter. Thus, the AIP can be used as an instrument for determining the conditions for scattering of impurities from instantaneous sources in the surface layer of the atmosphere. Author

N64-20227 Joint Publications Research Service, Washington, D.C.

EXPERIMENTAL INVESTIGATION OF THE DISPERSION OF IMPURITIES FROM INSTANTANEOUS SOURCES

P. M. Mushenko *In its* Turbulent Diffusion in the Surface Layer of the Earth's Atmosphere 6 May 1964 p 302–316 refs (See N64-20201 13-21) OTS: $5.00

The following were used as instantaneous sources: (1) smoke signal rockets producing a red smoke; and (2) charges carried aloft by pilot balloons. The charges were carried aloft by rubber envelopes filled with hydrogen, and were attached to the pilot balloons 1.0 to 1.5 m below the envelope in such a way that the influence of the balloon on the formation of the cloud of impurities was quite small. The entire period of the apparent development of the cloud of impurities, beginning from the time of the explosion and lasting to total disappearance of the cloud, was photographed on movie film through theodolite. The cross sections of clouds were determined through the effective radius of the cloud; each outline of the cloud was represented in the form of a circle of equivalent area with the radius r. On the basis of measurement data, curves were constructed that showed the dependence of the mean square effective radius on time. An equation is given from which it is possible to determine the square of the turbulent velocity from the apparent scattering of a cloud of impurities. R.T.K.

N64-20278 Bollay (E.) Associates, Inc., Santa Barbara, Calif.

CONFIGURATION OF WEATHER FACILITIES FOR METROPLEX TERMINAL AREAS Final Report

W. Slover Jan. 1964 89 p refs
(FAA Contract ARDS-554)
(RD-64-32)

This study develops the observing and communication details of a mesoscale weather network to support the air traffic control system in high-density terminal areas. Included is a review of terminal-area traffic control functions and required weather information, including short period forecasts (1 hour) for the terminal area; since such forecasts are not available today, observations are considered as their equivalent, and provision is made for observing the parameters that will likely be inputs to short period forecasting models. Nine metroplex cities are then selected for study, along with the test-bed at NAFEC. The "ideal" mesoscale network is described and its principles applied to the 10 terminal areas being considered. The problems existing in obtaining needed meteorological measurements are considered, and an optimum remote observing configuration, using existing meteorological sensors, is discussed. The engineering configuration and operation of the data collection network are described. Author

N64-20306 Army Electronics Research and Development Activity, Fort Huachuca, Ariz.

A NEW APPROACH TO THE NUMERICAL SOLUTION OF WIND SPIRALS Meteorological Research Notes No. 6

Bernard Marcus Apr. 1964 21 p refs
(USAERDAA-MET-1-64; AD-438507)

This problem grew out of earlier attempts to mathematically describe the spiral of the wind vector in the atmospheric boundary layer. The study was undertaken as a rigorous mathematical treatment of the basic equations to determine existence and uniqueness of a solution. However, this proved impractical. As a result, a theoretical mathematical study is made of a system of differential equations such that the solutions are spirals. The nature of the spiral is controlled by parameters. It is shown by example that, by selecting parameters carefully, solutions can be obtained that duplicate the mixing length selected by Ohmstede and Appleby. This technique offers an opportunity to study the spiral boundary layer from an entirely new approach. Author

N64-20309 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.

SCALE OF STRATOSPHERIC DETAIL STRUCTURE

Willis L. Webb Apr. 1964 21 p refs
(ERDA-130; AD-438843)

Sensitivities of wind and temperature measuring systems employed in the meteorological rocket network are adequate to provide vertical detail structure information for a few hundred meters in the stratosphere. In a few instances, data in the horizontal plane were obtained with sensitivities of the order of a few kilometers. The wind data were analyzed and discussed in the light of existing theories of the functional characteristics of the stratosphere as a medium for the generation and/or transportation of an energy flux, particularly of the type characterized by pressure perturbations. The results are consistent with both modes of operation, illustrating features to be expected in the propagation of internal waves, and also illustrating evidence of internal generation of the detail structure in the upper stratosphere. The latter becomes apparent in the 200 to 1,000 meter scale range above 50 km altitude where the stratospheric jet stream is intense and the thermal stability is decreasing. Vertical scales of detail structure in the stratosphere were evaluated at 35 km to be approximately 800 meters in the winter case and 1,000 meters in the summer case. Values of 1,600 meters and 2,200 meters were obtained for the respective cases at the 55-km level. Extrapolation of these data and the 6-km values reported by Greenhow provide estimates of jet stream and surface vertical scales of 300 to 350 meters and 200 to 250 meters, respectively. Author

N64-20333 Army Signal Research and Development Labs., Fort Monmouth, N.J.

SHORT-TERM VARIABILITY OF ROCKET WINDS

Marvin Lowenthal Sep. 1963 24 p refs
(USAELRDL-TR-2369; AD-423775)

Data for the Meteorological Rocket Network have been used to determine short-period variability of rocket winds. Measurements made at periods from 5 min to 1 1/2 hr have been utilized to determine the mean vector differences between observations. Variability appears to be dependent on height when all observations are included and independent of season. When selected observations are used, eliminating those with obvious errors, this variation with height is no longer discernible. Some methods of smoothing to eliminate measurement errors are discussed. Author

N64-20428 Buenos Aires U. (Argentina)
MEASUREMENTS ON DIFFUSION OF SILVER IODIDE NUCLEI IN THE ATMOSPHERE [MEDIDAS DE DIFUSION DE NUCLEOS DE IODURO DE PLATA EN LA ATMOSFERA] Report No. 2
Rosa G. de Pena, Emilio A. Caimi, and Julio V. Iribarne 1963 38 p refs In SPANISH

Measurements of ice nuclei were made at different altitudes in the area of Mendoza on days when silver iodide was seeded from the ground and on control days. All measurements were made in conditions of vertical instability, when the sounding showed a dry adiabatic lapse rate up to ca. 2 km over the ground. In this layer, winds were weak and came from the eastern sector. Seeding was performed with 100 charcoal generators distributed in lines running from north to south, in an area of about 4,000 km^2. Thirteen more generators were located near the Andes Mountains in the west. The results show that the turbulent diffusion in the atmospheric conditions of the experiments is effective in transferring the ice nuclei seeded at the ground up to the level of the cloud base (between 2,000 and 2,500 m above the ground). R.T.K.

N64-20432 Buenos Aires U. (Argentina)
EXPERIMENT ON HAIL PREVENTION IN THE PROVINCE OF MENDOZA, SEASONS 1959-60, 1960-61 AND 1961-62 Report No. 3
Hector N. Grandoso and Julio V. Iribarne (Inst. de Fis. de la Atmosfera) 1963 73 p refs In SPANISH

The object of the experiment is to find out whether cloud seeding will permit a significant reduction in the hail damage sustained by vineyards in the Mendoza area. In order to evaluate the effect of seeding with silver iodide, reports of hail damage by vineyards in the seeded area were used. The information for each hailstorm day included location, date, hour, the affected area, and the percentage of damage due to hail. The results of the evaluation are presented in tabular form. R.T.K.

N64-20444 IIT Research Inst., Chicago, Ill. Technology Center
OZONE MEASUREMENT SURVEY IN COMMERCIAL JET AIRCRAFT
Robert I. Brabets Washington, FAA, Nov. 1963 58 p refs
(Contract ARDS-608)
(FAA-ADS-5)

A survey was made to measure ozone concentrations in CAR-4b jet aircraft cabins and cockpits on flights above 25,000 ft to obtain a 12-month evaluation with emphasis on seasonal and meteorological correlation and locate and chart ozone-enriched air masses to obtain further correlations and to find any abnormal conditions that result in high ozone concentration. For a year, 285 flights of all types of jets now used by US carriers, covering all the US and parts of Canada and the North Atlantic, were monitored. The data showed: (1) external ozone enters via the pressurization system; (2) ozone concentration varies with altitude, latitude, and season; (3) pressurization systems of various aircraft do not differ in ozone-decomposing efficiency; (4) internal ozone concentration is negligible on flights made below the tropopause. Author

N64-20531 Lockheed Missiles and Space Co., Sunnyvale, Calif.
DETECTION TECHNIQUES AND ATMOSPHERIC DISPERSAL OF TOXIC GASES AND AEROSOLS: AN ANNOTATED BIBLIOGRAPHY
Charlie M. Pierce, comp. Apr. 1963 65 p refs
(SB-63-39; Rept.-3-32-63-1)

Potential and actual environmental hazards from diffusible toxic agents and the use of meteorology to help evaluate, understand, and minimize these hazards have become increasingly significant. The scope of this bibliography includes such areas as detection techniques and instrumentation, dispersion by winds, and the physiological effects of atmospheric contaminants. The references are arranged according to the first author, wherever possible. Indexes for corporate author, personal author, and subject are included. Author

N64-20581* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DIRECTIONAL WIND COMPONENT FREQUENCY ENVELOPES, CAPE KENNEDY, FLORIDA, ATLANTIC MISSILE RANGE
Orvel E. Smith and Glenn E. Daniels 21 Feb. 1964 19 p refs
(NASA TM X-53009) OTS: $1.60 ph

This report is a first attempt to present data for use in developing idealized wind component profiles analogous to the synthetic windspeed profiles presently being used for aerospace vehicle design criteria. Due to the predominance of strong westerly winds in winter and light but persistent easterly winds in summer in the troposphere over Cape Kennedy, some potential gain in structural and control system design requirements may be realized by using directionalized synthetic wind profiles instead of the present nondirectional windspeed synthetic profiles. The extent of a design gain depends upon the flight azimuth restrictions imposed on the vehicle and the response characteristics of a given vehicle configuration. Author

N64-20592* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DIRECTIONAL WIND COMPONENT FREQUENCY ENVELOPES, SANTA MONICA, CALIFORNIA, PACIFIC MISSILE RANGE
Orvel E. Smith and Glenn E. Daniels 9 Mar. 1964 19 p refs
(NASA TM X-53021) OTS: $1.60 ph

Directional Wind Component Frequency Envelopes for Santa Monica, California, based on the "windiest monthly period" concept, are presented for use in structural and control studies in the design of aerospace vehicles. Author

N64-20606* Chicago U., Ill.
TIROS III MEASUREMENTS OF TERRESTRIAL RADIATION AND REFLECTED AND SCATTERED SOLAR RADIATION Research Paper No. 20
S. H. H. Larsen, T. Fujita, and W. L. Fletcher Oct. 1963 16 p refs
(NASA Grant NsG-333; Grant CWB-WBG-6)
(NASA CR-56033) OTS: $1.60 ph

The distribution of outgoing terrestrial radiation within the 8- to 12-micron band, over North Africa, is presented together with the pattern of reflected solar radiation. The analyses were

based on data from analog traces of the 5-channel medium-resolution scanning radiometer on Tiros III. The data used were obtained from measurements made under conditions favorable to the angular resolution of the radiometer, which changes as the satellite spins and progresses along its path; and a pattern of differential heating over the desert area was observed. Calculations of the rate of reflectance over the Sahara desert were made, and the values obtained over the sand dunes, about 23%, were realistic. These radiation data have also been used in a study of the anisotropic nature of scattered radiation. The results of this approach indicate the ability of the satellite to give valuable measurements in the study of scattering properties of the atmosphere. Author

N64-20648 Buenos Aires U. (Argentina)
INFLUENCE OF HYGROSCOPIC AND ICE NUCLEI ON THE INITIAL PRECIPITATION LEVEL [INFLUENCIA DE LOS NUCLEOS HIGROSCOPICOS Y GLACIOGENOS EN EL NIVEL INICIAL DE PRECIPITACION] Report No. 1
Jorge A. Pena 1963 24 p refs In SPANISH

Many factors, particularly the temperature of the cloud-base, the updraft velocities, and the composition of the atmospheric aerosol, determine which of two mechanisms (the Bergeron–Findeisen or the coalescence process) prevails in the atmospheric condition in which hailstorms develop in Mendoza. The relationship of these factors to the stimulation of precipitation was investigated by seeding the clouds with freezing nuclei or with giant hygroscopic nuclei. R.T.K.

N64-20689* Smithsonian Astrophysical Observatory, Cambridge, Mass.
THE TEMPERATURE ABOVE THE THERMOPAUSE
Luigi G. Jacchia 22 Apr. 1964 35 p refs
(NASA Grant NsG-87-60)
(NASA CR-56102; SAO Special Rept. 150) OTS: $3.60 ph

The conversion of upper atmosphere densities to temperatures by means of atmospheric models, whether time-dependent or steady-state, is subject to limitations, which are critically examined. Nicolet's steady-state model is used to obtain temperatures from the drag of five artificial satellites in the time interval from 1958 to 1963. The temperature variations with solar and geomagnetic activity are reviewed. The relation between the day and night temperatures averaged over one solar rotation and the corresponding decimetric solar flux shows a definite departure from linearity, which is just about the same for the 8-cm and the 10.7-cm flux. The diurnal variation is a very stable feature; its 2 PM maximum and 4 AM minimum do not show any appreciable shift with solar activity, nor does the ratio of the maximum to the minimum temperature, which is close to 1.30. An analytical model of the diurnal variation is presented as a function of solar time and latitude. A practical method for the computation of exospheric temperatures as a function of geographic, solar, and geomagnetic parameters is schematically presented. Author

N64-20704* RAND Corp., Santa Monica, Calif.
QUARTERLY STATUS REPORT, 12 DECEMBER 1963 - 11 MARCH 1964
Y. H. Katz [1964] 2 p refs
(NASA Contract NASr-21(07))
(NASA CR-58133; AR-130-NASA) OTS: $1.10 ph

The current program includes the following: (1) The data reduction transformations of the cloud pattern samples have been completed, and the derived cloud statistics and extractions of significant pattern features, viz, the coherence of the measurements within each pattern class and the variation between classes, are being analyzed. (2) A report on the feasibility of determining high-altitude water vapor from a satellite was forwarded to NASA. (3) The two-layer primitive equation model developed by Mintz et al for the study of the Earth's general circulation is being modified for application to the circulation of Mars. The most important changes relate to the incorporation of different methods for calculating radiative and subgrid-scale convective heat transfer and subgrid-scale momentum transfer. Divine's model of radiative transfer by CO_2 is being incorporated into the program. Other important differences between the calculations for Mars and Earth will include an assigned finite heat capacity for the Martian surface (estimated from the diurnal temperature variation), and a diurnal variation in heating. I.v.L.

22 NAVIGATION AND GUIDANCE

Includes autopilots; star tracking; inertial platforms; and air traffic control. *For related information see*: 06 Auxiliary Systems; 08 Communications; 09 Electronics; 10 Facilities, Research and Support; 15 Instrumentation and Photography; 20 Mathematics; and 29 Space Sciences.

N64-20136 Pickard and Burns Electronics, Waltham, Mass.
ATOMIC OSCILLATOR DEVICE FOR NAVIGATION-GUIDANCE Interim Engineering Report No. 2
R. H. Woodward, L. Johnson, R. Sanborn, I. Felch, and R. L. Smith Wright-Patterson AFB, Ohio, ASD, 20 Mar. 1964 88 p refs
(Contract AF 33(657)-11384)
(Publ. 877; ASD-TDR-64-2; AD-434078)

The atomic oscillator device for navigation-guidance is a two loop, frequency control system. The primary loop proportionally controls the primary (crystal) oscillator to an exact submultiple of the cesium resonance frequency; reference for control signal is supplied by a cesium beam tube. The equilibrium frequency of the primary oscillator is not, however, an integer frequency when expressed in cycles per astronomical second. The secondary loop, therefore, servocontrols the secondary oscillator to 5 mg/sec; reference for servocontrol is supplied by the primary oscillator output. Components for the primary loop were considered in terms of theory of operation, system analysis and specification, and breadboard evaluation of many design techniques. Many useful critical components were produced. Several approaches to the multipole beam optics problem were fed to a computer. To maximize system accuracy, theoretical investigations of possible distortions were undertaken to insure that design specifications will lead to the required accuracy. Author

N64-20265 Northrop Corp., Hawthorne, Calif. Nortronics Div.
COMPARISON OF PREDICTED AND MEASURED VIBRATION ENVIRONMENTS FOR SKYBOLT GUIDANCE EQUIPMENT
J. M. Brust and H. Himelblau *In* Defense Dept. Shock, Vibration and Assoc. Environ., Pt. 3 Mar. 1964 p 231–280 refs
(See N64-20235 13-01)

A modification of the Mahaffey–Smith procedure was utilized to predict the vibration environment of guidance equipment for the Skybolt air-launched ballistic missile during B-52F takeoff and missile postlaunch conditions, and to establish design and test criteria for the hardware. A comparison is

made with actual vibration measurements during aircraft take-off and missile flight. Improvement of the prediction procedure is indicated. Comparison is also made with other prediction techniques. Author

N64-20374 Navy Electronics Lab., San Diego, Calif.
ESTIMATING THE ACCURACY OF NAVIGATION SYSTEMS
E. R. Swanson 24 Oct. 1963 15 p refs
(NEL-1188; AD-427269)

A method involving system geometry and a simple estimate of the statistical repeatability of measurement was developed to determine the circular error probable in a navigational fix. The method, which is illustrated with an example, is directly applicable to the design or evaluation of hyperbolic systems such as Omega and Loran. Author

N64-20440 Applied Psychology Corp., Arlington, Va.
THE ROLE OF OPTICAL DEVICES IN MID-AIR COLLISION PREVENTION Final Report No. 5
Nov. 1963 79 p refs
(Contract FAA/BRD-127)
(FAA-RD-64-2)

Literature relevant to promising optical aids is reviewed, including sunglasses, visors, goggles, telescopes, binoculars, periscopes, sighting levels, collimated reticles, rearview mirrors, and closed-circuit television. No one optical aid can provide adequate assistance over the entire range of visual conditions found in flight. Sunglasses provide a number of advantages including the reduction of glare and the immediate and cumulative effects of exposure to high brightness levels. Telescopes and binoculars can assist in making inferences about detected aircraft, but will not materially assist in searching. Rear vision may be increased by mirrors, but mirror vibrations and vibrations acting upon the pilot degrade visual performance. Pilots are encouraged to use light filters (sunglasses or sun visors), to install and use rearview mirrors when possible, and to use sighting levels to aid judgments of relative altitude. Author

N64-20522 Civil Aeronautics Board, Washington, D.C.
AIRCRAFT ACCIDENT REPORT: AAXICO AIRLINES, INC., C-46-F, N67941, NEAR GREAT FALLS, MONTANA, AUGUST 14, 1963
1 May 1964 17 p
(Rept. 1-0010)

The aircraft crashlanded in a plowed field and skidded into a small earthen dam. The crash occurred after the pilot failed to maintain altitude and appropriate single-engine airspeed following the shutdown of the right engine. The aircraft was substantially damaged, but there was no fire. It was determined that the probable cause of this accident was the failure of the captain to effect a proper and timely assessment of a powerplant malfunction, followed by improper judgment and technique during a single-engine emergency operation. Author

N64-20586* Massachusetts Inst. of Tech., Cambridge Experimental Astronomy Lab.
SELECTION OF OPTICAL SIGHTINGS FOR POSITION DETERMINATION IN INTERPLANETARY SPACE
Robert G. Stern Apr. 1964 28 p refs Presented at the Natl. Aerospace Electron. Conf., IEEE, Dayton, 12 May 1964 Submitted for Publication
(NASA Grant NsG-254-62)
(NASA CR-53989; RE-7) OTS: $2.60 ph

A self-contained optical system for the determination of position in interplanetary space is examined. The measured quantities are the angles between pairs of celestial bodies. The specific problem studied is the selection of the angles to be observed such that the uncertainty in position estimation, due to noise in the measurements, is minimized. The approach used is geometric. To reduce the amount of fuel required, practical interplanetary vehicles will move in trajectories that lie close to the ecliptic plane. The planets also move in orbits that lie close to the ecliptic plane. For the determination of vehicle position in the nominal trajectory plane, stars whose lines of sight lie close to the ecliptic plane are used; for position determination normal to the nominal plane, a star whose line of sight is approximately normal to the ecliptic is required. Author

23 PHYSICS, GENERAL

Includes acoustics; cyrogenics; and optics. *For astrophysics see*: 05 Astronomy and Astrophysics. *For related information see*: 12 Geophysics; 29 Space Sciences; 24 Physics, Plasma; and 25 Physics, Solid-State.

N64-20003* Florida U., Gainesville
QUANTUM THEORY STUDIES OF THE ENERGIES OF EXCITED STATE ATOMS AND MOLECULES, PARTICULARLY AS THEY OCCUR IN THE UPPER AND STELLAR ATMOSPHERES, AND IN MATERIALS UNDERGOING COMBUSTION Semi-Annual Status Report No. 1, 1 Oct. 1963-31 Mar. 1964
Per-Olov Löwdin 31 Mar. 1964 4 p
(NASA Grant NsG-512)
(NASA CR-53704) OTS: $1.10 ph

The main emphasis was placed on the study of the fundamental quantum theory of excited states of simple atoms and molecules present in the upper atmosphere and on the theory for excited states. Special attention was paid to the problem of finding both upper and lower bounds for the energy values of the stationary states as well as for other quantities. The "partitioning technique," which is an approach to infinite-order perturbation theory, was studied. In addition, fundamental problems connected with the time-dependent Schrödinger equation were studied. R.T.K.

N64-20007* Stanford Research Inst., Menlo Park, Calif.
MAGNETIC PROPERTIES OF SOME MACROMOLECULES OF BIOLOGICAL INTEREST Quarterly Progress Report No. 2, 1 Nov. 1963-1 Feb. 1964
Bascom S. Deaver, Jr. 31 Mar. 1964 17 p refs
(NASA Contract NASr-49(16); SRI Proj. 4644)
(NASA CR-53687) OTS: $1.60 ph

The aims of this program are to measure the magnetic susceptibility of some selected macromolecules, using a new superconducting detection system, and to correlate the results of these measurements with the structure and with the physical and chemical properties of the compounds. Of particular interest is the possibility of detecting effects due to the quantized collective motion of electrons in large organic molecules. When these molecules are subjected to high magnetic fields, their diamagnetic susceptibility may change in a way that will be related to the multiple connectivity of the molecules. These changes may give information about molecular structure, and it then may be possible to identify certain biological molecules by magnetic susceptibility measurements. To date, all the components of the susceptibility cryostat have been completed and assembled. Experiments (at liquid helium temperatures) were conducted, for approximately 3 weeks, to test

and calibrate the apparatus. A sample of coronene, $C_{24}H_{12}$, has been purified by multiple recrystallization, and its purity has been checked by its ultraviolet spectrum. This material will be used for the initial susceptibility measurements. I.v.L.

N64-20029 Sylvania Electric Products, Inc., Mountain View, Calif.
OPTIMIZED COHERENT OPTICAL RECEIVER TECHNIQUES
Mahlon B. Fisher Griffiss AFB, N.Y., RADC, Mar. 1964 23 p
(Contract AF 30(602)-3162)
(RADC-TDR-64-74; AD-438973)

The design and testing of the image-dissector electron gun was successfully completed. The scanning capability of the electron gun was demonstrated by the video presentation and tracking of a small spot of light at any point on the photosurface. The optimum values of magnetic deflection and focusing fields were within 10% of the design values. Work on the final phase of the program was started with the construction of the first complete scannable microwave photodetector.

Author

N64-20035 ARO, Inc., Arnold Air Force Station, Tenn.
OBSERVATIONS OF HYPERVELOCITY IMPACT OF TRANSPARENT PLASTIC TARGETS
Ray Kinslow Arnold Eng. Develop. Center, May 1964 48 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-49; AD-438947)

Targets of transparent plastic have been impacted with small projectiles at velocities up to 25,000 fps. Photographs made at the rate of approximately 6×10^5 frames per second show the projectile impact, luminous flash, crater formation, and shock waves in the target. Propagation of the waves and their reflections, and the fractures that they produce, are analyzed. Spalling near the rear surface of the target is seen as the shock is reflected as a tensile wave. Studies of impact of laminated targets show transmission and reflection of shock waves at each interface together with details of the complex fracture formation. These are also analyzed. A theory of fracture is presented that indicates that the fracture of Plexiglas or Lucite is time-dependent. The effects of the target's rear surface and the target temperature are discussed. It is shown that most of the effects of hypervelocity impact may be simulated by the use of explosives placed in small holes in the target face. Author

N64-20076 ARO, Inc., Arnold Air Force Station, Tenn.
CAPTURE COEFFICIENTS OF GASES AT 77°K
R. F. Brown and E. S. J. Wang Arnold Eng. Develop. Center, May 1964 47 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-37; AD-438484)

The capture coefficients for 13 common gases at 77° K cryosurface temperatures are presented. Several parameters were employed for correlating these capture coefficients. Generally, the capture coefficient decreased with decreasing molecular weight, decreasing heat of condensation, and increasing Debye characteristic temperature. Hydrogen bonding in a molecule tended to increase the capture coefficient beyond the expected value. Two empirical parameters—one involving surface area of the molecule and the square root of the molecular weight, and the other involving surface energy of the molecule and the inverse square root of the molecular weight—appear to give the satisfactory correlation for capture coefficients.

Author

N64-20081 Michigan U., Ann Arbor Inst. of Sci. and Tech.
EFFECT OF SURFACE DEFORMATIONS IN ROTATING OBLIQUE SCANNING MIRRORS ON IMAGE QUALITY IN FLYING-SPOT SCANNERS
William L. Brown, Max E. Bair, and Richard F. Nalepka Apr. 1964 16 p refs
(Contract DA-36-039-SC-78801; Proj. Michigan)
(Rept. 2900-469-T; AD-437791)

An experimental and theoretical program concerning the distortion of a deviating flat mirror under high-speed rotation about an axis at 45° to its normal is discussed, and the results are compared. The degradation in image quality imposed by the distortions in such mirrors can be predicted to a fair degree of accuracy by using a relatively simple function, which relates the contributing factors to the image degradation.

Author

N64-20090 Ohio State U. Research Foundation, Columbus Antenna Lab.
COMPARISON OF THE SUPERPOSITION APPROXIMATION AND THE MODIFIED GEOMETRICAL OPTICS METHOD FOR RADAR CROSS SECTIONS OF DIELECTRIC-CLAD BODIES Scientific Report No. 23
T. Kawano, L. Peters, and W. G. Swarner 15 Nov. 1963 18 p refs
(Contract AF 19(604)-7270)
(Rept. 1116-41; AFCRL-64-46; AD-437585)

Two approximate methods, the superposition approximation and the modified geometrical optics method, for obtaining the radar cross sections of dielectric-coated or plasma-coated bodies are compared. The superposition approximation yielded more accurate results for smaller inner bodies, and the modified geometrical optics method was more accurate for larger inner bodies. The superposition approximation is extended to include the possibility of a dielectric inner body, and some results are presented for this new application. The modified geometrical optics method was previously extended to include the case of a layered cylindrical body, provided that nonaxis rays did not contribute significantly to the radar cross section; numerical results obtained using this method are presented. Author

N64-20096 Edgerton, Germeshausen and Grier, Inc., Boston, Mass.
PRE-BANSHEE CALIBRATION DETONATION
Clyde B. Dobbie and Charles S. Fitzgerald 11 Dec. 1963 29 p
(Contract DA-49-146-XZ-092)
(EG&G-B-2687; DASA-1446; AD-437630)

Electromagnetic measuring equipment was installed at Aberdeen Proving Grounds, Maryland, and operated during the sea-level detonation of a spherical 500 lb-Pentolite charge. The purpose of this project was to check the operational readiness of the equipment to be used during the Banshee test series, to obtain some indication of its em detecting capabilities, and additionally to obtain a crude measure of the em signal generated by such a detonation for use in future calibrations. Each set of equipment used consisted of three mutually orthogonal loop antennae, low level amplifiers and matching networks, a 4-channel tape recorder, and a Fiducial generator Type TD-2A. A signal was detected on only one antenna located 1,000 ft from the detonation. Uncertainties regarding the source and character of the detected signal exist. Author

N64-20113 RAND Corp., Santa Monica, Calif.
STATISTICAL PROPERTIES OF THE BLACK BODY RADIATION FIELD
Dennis Holliday Dec. 1963 9 p refs
(P-2844; AD-428088)

It has been demonstrated that the blackbody radiation field is an example of a quantized field excited by a c-number source when the c-number part of the field is a gaussian random process with an average energy per mode given by the Planck formula. The proof of this is straightforward. A quantized real scalar field excited by a c-number source, which is "turned on" at time t_1 and "turned off" at a later time t_2, is described in the Heisenberg picture by the state vector $|0; in >$ and, after the time t_2, by a hermitian field operator $\phi_{out}(x)$. Author

N64-20116 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
METHOD OF ADDITIONAL STRAINS IN PROBLEMS OF PLASTICITY THEORY
I. A. Birger 22 Aug. 1963 20 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 1, 1963 p 47–56
(FTD-TT-63-642/1+2+4; AD-428313)

The relations between the components of the strain deviation and the stress deviation in the deformation theory of plasticity are considered. A method of successive approximations for determining the plastic deformation is outlined. A few examples in which this method is used successfully are included. R.T.K.

N64-20133 Brown U., Providence, R.I. Div. of Applied Mathematics
A GENERALIZATION OF THE LAME AND SOMIGLIANA STRESS FUNCTIONS FOR THE DYNAMIC THEORY OF LINEAR VISCOELASTIC SOLIDS Technical Report No. 26
W. S. Edelstein and M. E. Gurtin Apr. 1964 17 p refs
(Contract Nonr-562(25))
(AD-436826)

Solutions of the displacement equations of motion appropriate to the dynamic linear theory of homogeneous isotropic, viscoelastic solids were studied. Generalizations to the viscoelasticity of the Lamé and Somigliana stress-function solutions of elastodynamic are introduced. The completeness of the generalized Lamé functions are established, and the results are used to prove the completeness of the viscoelastic Somigliana solution. As a corollary of the completeness of the Lamé solution, it is shown that every displacement field can be decomposed into the sum of a solenoidal and an irrotational vector, each of which satisfies a hereditary wave equation. For the case of nonzero body forces, the viscoelastic Lamé stress functions transform the displacement equations of motion into a set of hereditary Lorenz equations. A particular solution for these Lorenz equations is derived by means of Laplace transforms. It is also shown that any solution to the iterated hereditary wave equation can be decomposed into a sum of two solutions of hereditary wave equations. P.V.E.

N64-20144 General Dynamics/Astronautics, San Diego, Calif. Space Science Lab.
RE-ENTRY PHYSICS RESEARCH Annual Report, Oct. 1962–Dec. 1963
Mar. 1964 101 p refs
(Contract DA-04-495-ORD-3383(Z); ARPA Order 393-63; Proj. Defender)
(GDA-DBE-64-010; AD-434567)

The following are included among the reports: high-temperature shock-tube CO_2-transmission measurements at 4.25μ; chromatographic determination of prepared test-gas mixtures; analytical microwave-wake interaction studies; equilibrium properties of air with additives; hypervelocity wake-brightness temperature measurements; and concentration time histories of CO_2 behind shock waves traveling through argon-diluted mixtures of CO and O_2. A.W.

N64-20162 Oklahoma U. Research Inst., Norman
RESEARCH DIRECTED TOWARD THE STUDY OF THE STRUCTURAL AND ULTRAVIOLET SPECTRA OF FREE RADICALS, MOLECULES AND MOLECULAR IONS USING THEORETICAL AND COMPUTATIONAL METHODS Final Report
Feb. 1964 85 p refs
(Contract AF 19(604)-5576)
(AFCRL-64-123; AD-437952)

An extensive investigation has been made concerning the energies and wave functions of the NO molecule with particular emphasis on the hyperfine structure constants and the ultraviolet spectrum. The magnetic hyperfine structure constants calculated from the self-consistent field molecular orbitals agree well with the experimental values and, except for the Fermi contact coupling term, are not much affected by the configuration interactions. Calculations of the electronic structures of the NO^+ ion and the excited states of NO have been given. The theoretical ionization energy of NO was obtained as 7.48 ev, which compares satisfactorily with 9.25 ev from experiment. The electronic structure of NO_2 and related molecules is discussed by means of a correlation diagram between the molecular orbitals of O_3 and CO_2. The general properties of the hyperfine structure constants for the different kinds of orbitals are discussed and compared with the experimental results of NO_2 and ClO_2. A general theory of the Rydberg levels of molecules has been developed. Author

N64-20275 Boeing Scientific Research Labs., Seattle, Wash. Solid State Physics Lab.
THE ANALYSIS OF FRACTURE SURFACES BY ELECTRON MICROSCOPY
Regis M. N. Pelloux Dec. 1963 78 p refs
(DI-82-0169-RI; AD-428452)

This work reviews and illustrates the characteristic features of the following modes of fracture: (1) transgranular fracture, which can take place either by cleavage along crystallographic planes, by the formation and coalescence of microvoids that leave concave depressions called "dimples" on both fracture surfaces, or by the slow progression of a fatigue crack by a mixed ductile–cleavage mode of fracture; and (2) intergranular fracture, which is either brittle when there is a perfect separation of the grains along the grain boundaries, or ductile when this separation is associated with the plastic formation of void along the grain boundaries. Author

N64-20293* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE INFLUENCE OF AIRPLANE CONFIGURATION ON SONIC-BOOM CHARACTERISTICS
Harry W. Carlson *In* AIAA Vehicle Design and Propulsion [1963] p 92–97 refs (See N64-20292 13-04)
AIAA: $5.00 members, $10.00 nonmembers

Both wind-tunnel and flight tests have demonstrated conclusively that both volume and lift effects contribute to bow-shock overpressures. Experiment has shown that existing theory provides reasonably accurate estimates of overpressure, both for cases of thickness (or volume) alone and for a combination of thickness and lift. Additional developments of the theory have made possible the definition of a lower bound of sonic-boom overpressure that depends only on airplane length, weight, base area (including jet-exhaust and wake effects), and

flight conditions. A corollary of the lower-bound concept provides airplane design methods that theoretically allow lower-bound overpressure values to be achieved. Author

N64-20302 Pennsylvania U., Philadelphia
DETERMINATION OF HYPERFINE INTERACTIONS IN SOLIDS BY THE USE OF RADIOACTIVE NUCLEI Final Report, 15 Oct. 1960-14 Jan. 1964
M. E. Caspari and S. Frankel 15 Apr. 1964 5 p
(Grants DA-ORD-31-124-61-G38; DA-ARO(D)-31-124-G66)
(AROD-3006-6; AD-438046)

Discussed are experiments in progress that are concerned with measurements of the magnetic hyperfine interaction, the electronic relaxation time, and the g-factors of excited nuclear states in rare earth ions of garnets and metallic compounds by γ-γ angular correlation techniques. Published papers concerning such measurements are listed. Work has been started on the design and construction of an apparatus for Mössbauer experiments involving rare earth nuclei. The apparatus has a linear velocity drive controlled by feedback and makes use of multiscalar detection. I.v.L.

N64-20326 Naval Research Lab., Washington, D.C. Electronics Div.
A BRIEF SURVEY OF ELEMENTARY THERMOELECTRIC THEORY
William H. Lucke 3 May 1963 17 p refs
(NRL-5888; AD-405854) OTS: $0.50

The three fundamental effects of thermoelectricity—Seebeck, Peltier, and Thomson—are presented, and the corresponding coefficients are defined. Following a simplified derivation of the Kelvin relations, a more sophisticated and detailed presentation of the irreversible thermodynamic approach to these relations was made. These relations are valid in spite of the arbitrary assumptions as to the separation of thermal and electrical conduction made in the former derivation. A brief summary is given of a derivation of the expression for the Seebeck coefficient based on a quasi-free electron model and simple energy dependence of an isotropic relation time. The attempt to apply band theory to the search for better thermoelectric materials is very briefly described, and some interesting ideas for improvement are mentioned along with criticisms concerning predictions of the maximum possible figure of merit. Author

N64-20344 Ohio State U. Research Foundation, Columbus Antenna Lab.
A MEMORANDUM ON PARAMETRIC INTERACTIONS OF RADIATION AND MATTER Report 1579-8
H. Hsu 15 Jan. 1964 31 p refs
(Contract AF 33(657)-10824)
(AD-432060)

The study of parametric interactions was limited primarily to electromagnetic waves. A broader and more important aspect of parametric interactions was revealed by interpreting these interactions, classically, as the scattering of waves or, quantum-mechanically in terms of collision of quantized particles. The particle view interpreted the parametric interactions as creation or annihilation of photons, phonons, magnons, etc., including all types of quasi-particles. Implied is the possibility of achieving parametric amplification, generation, or frequency conversion involving acoustic waves and magnetic spin waves, etc., as well as electromagnetic waves. The basic concept of these interpretations and some of the physical properties of these interactions are described. Author

N64-20347 Aberdeen Proving Ground, Md. Ballistics Research Lab.
OBSERVATIONS OF CRATER GROWTH IN WAX
Lee S. Holloway Oct. 1963 17 p refs
(BRL-1526; AD-437162)

Radiographic observations of crater growth in wax under hypervelocity impact conditions are reported. At an impact velocity of 4 km/sec, craters reached their maximum depth in about 200μs, and subsequently rebounded to 60% of their maximum depth. Author

N64-20349 Army Cold Regions Research and Engineering Lab., Hanover, N.H.
METHOD OF DETERMINING DYNAMIC PROPERTIES OF VISCO-ELASTIC SOLIDS EMPLOYING FORCED VIBRATION
Tung-Ming Lee Nov. 1963 15 p refs
(Res. Rept.-122; AD-437132)

The dynamic properties of viscoelastic solids are evaluated by using the forced longitudinal and torsional vibration techniques. A method of eliminating experimental difficulties due mainly to the coupling of sample with supporting system is introduced in using R_{max} (the maximum amplitude ratio of the free end of a sample to the end attached to a driver) and f_{ro} (the corresponding vibration frequency) as a criterion. Experimental measurements of these values are sufficient to determine the dynamic properties of samples. The complex modulus is used to describe the stress–strain relationship for a viscoelastic solid. Simple expressions relating dynamic properties to R_{max} and f_{ro} are obtained. In the method presented, matching of natural frequencies of the sample and the driver is not necessary, and the same driving unit may be used throughout the experiment. The expressions derived for longitudinal and torsional vibrations bear direct relationship between the measured items and the dynamic properties and are simple to use. Author

N64-20366 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
PRINCIPLES OF PROTON SYNCHROTRON THEORY
M. S. Rabinovich *In its* Trans. of the Physics Inst. 21 Mar. 1963 p 31–243 refs (See N64-20363 13-01)

This work on the principles of proton synchrotron theory consists of six chapters: (1) radial-phase oscillations; (2) fast-particle oscillations; (3) calculated values of deviations of the magnetic field; (4) resonance phenomena between fast and slow oscillations; (5) injection theory; and (6) theoretical investigation of free oscillations in strong-focusing accelerators. The main deductions are illustrated always with the data on the 10-Bev proton synchrotron, the magnet of which consists of four sectors (each 8 meters long) separated by linear gaps. A.W.

N64-20396 Battelle Memorial Inst., Columbus, Ohio
INFRARED SPECTRA INVESTIGATION OF PARA-SUBSTITUTED BENZENE COMPOUNDS Technical Documentary Report, Nov. 1961-Apr. 1963
R. J. Jakobsen Wright-Patterson AFB, Ohio, AF Mater. Lab., Dec. 1963 46 p refs
(Contract AF 33(657)-7440)
(ASD-TDR-63-869; AD-427976)

Complete vibrational assignments were made for a mono-substituted benzene with an electron-donating substituent (phenol) and one with an electron-attracting substituent (benzonitrile). In order to confirm the assignments and to obtain more information on the modes of vibration, ring-deuterated

aromatics, phenol and benzonitrile, were prepared and assigned. The effects of disubstitution were studied by making an assignment of p-cresol and several of its deuterated derivatives such as p-cresol-OD and p-cresol-d_4. By use of the results of these assignments and those available in the literature, frequency assignments in the CsBr spectral region (650-300 cm^{-1}) were made from the spectra of 279 benzene derivatives. These assignments include several benzene-like ring deformations and some vibrations that are either internal vibrations of the substituent group or involve the ring-substituent bond. The assigned frequencies show that group frequencies (or rather group perturbations) exist for benzene derivatives in the low-frequency region. Author

N64-20399 Stanford U., Calif. Microwave Lab.
MICROWAVE RESEARCH Quarterly Status Report No. 19, 1 Aug.-31 Oct. 1963
C. F. Quate et al Dec. 1963 29 p refs
(Contract Nonr-225(48))
(ML-1122; AD-428767)

Activities are reported in the following areas: (1) acoustic-wave amplification studies; (2) optical masers; (3) ferrited nonlinear propagation; and (4) transverse-field interactions of a beam and plasma. R.T.K.

N64-20406 Boeing Scientific Research Labs., Seattle, Wash.
LECTURES ON THE PROBLEM OF SPACE AND TIME IN EINSTEIN'S THEORY OF GRAVITATION Mathematical Note No. 328
Claus Müller (Tech. Hochschule Aachen) Oct. 1963 68 p refs
(DI-82-0312; AD-428446)

The geometrical properties of general smooth surfaces in three-dimensional Euclidean space are considered. Although the basic concepts were first introduced by Gauss, the notations and techniques employed make use of more recent developments. The basic problems of a general metric geometry, as they were first formulated by B. Riemann, are discussed. The basis of all physical measurements in Einstein's theory of gravitation is a four-dimensional metric continuum. In the present report, this continuum is constructed of space–time elements that are mathematically defined. R.T.K.

N64-20424 France. Ministere de l'Air, Paris
APPLICATION TO CONVECTION OF TEMPERATURE MEASUREMENT THROUGH LUMINESCENCE METHODS [APPLICATION EN CONVECTION DE LA MESURE DES TEMPERATURES PAR LES METHODES DE LUMINESCENCE] Scientific and Technical Publication No. 400
F. Fragnaud (Lab. de Thermodyn. de Poitiers) Paris, Service de Documentation Sci. et Tech. de l'Armement, 1963 32 p refs in FRENCH

A comparative study was made of two methods for measuring the temperature of a surface by photoluminescence. Both methods have the advantage of not being disturbed by heat flow. One method utilizes modifications of the fluorescent spectrum; the other utilizes the variation of the phosphorescence. The comparison was made from the point of view of the range of utilization, ease of measurement, and the precautions to be taken in obtaining good precision. Trans. by I.v.L.

N64-20425 France. Ministere de l'Air, Paris
CONTRIBUTION TO THE THEORIES OF HUYGENS PRINCIPLE AND OF THE DIFFRACTION [CONTRIBUTION AUX THEORIES DU PRINCIPE DE HUYGENS ET DE LA DIFFRACTION] Scientific and Technical Publication No. 401
Maurice Jessel (L'Ecole Super. De Phys. et De Chim. Ind.) Paris, Service De Documentation Sci. et Tech. de l'Armement, 1963 131 p refs In FRENCH

The purpose of this study is to perfect the formulation of the principle of Huygens and to adapt it to the resolution of rigorous problems of diffraction or of the interaction of boundaries. Ad hoc operators were employed to mathematically express the scanning of a given region in space. The equation derived was applied to the "telegraphist" equation and to Maxwell's equations. A problem of interaction, more general than the classical problems, was studied. This problem concerned a diffuse diopter consisting of an inhomogeneous zone establishing a transition between the first homogeneous medium and a second equally homogeneous medium. The known procedures for resolving the functional equations pertinent to problems of diffraction and interaction were examined. These procedures involved iteration, algebra, and the variational technique. The integral equations of a diffuse diopter in the presence of an electromagnetic wave were investigated. Due to the complexity of these equations, a valid first approximation for a perfectly conducting screen, pierced by an aperture, was employed. When the screen was plane and slender, the formulas of H. Severin were used. The formulas of Kottler correspond to the "black" screen, i.e., a perfect absorbent. I.v.L.

N64-20429 Nihon U., Tokyo (Japan) Atomic Energy Research Inst.
[ACTIVITIES OF THE ATOMIC ENERGY RESEARCH INSTITUTE – 1963] Annual Report
O. Hara [1964] 63 p refs
(NUP-64-2)

Research activities in the following areas are discussed: (1) experimental and theoretical plasma physics; (2) solid-state physics; and (3) theoretical physics (high- and low-energy physics). Experimental plasma-physics activities are concerned mainly with the production of a high-temperature helium plasma, the study of the behavior of this plasma, and the detection of hard X-rays with an energy of 300 kev during the half cycles preceding plasma formations. Theoretical plasma-physics activities are concerned mainly with the theory of the resonance probe, the theory of a degenerate electron gas, the problems of plasma stability, and theoretical analyses of irreversible expansion heating experiments. The research fields of the solid-state division deal with low-temperature physics and magnetism. The major activities in the area of theoretical physics include the internal structure of elementary particles, the solution of the Bethe–Salpeter equations for scattering problems, beta-decay, and the collective excitation modes in nuclei. Also, a list of publications in the above-mentioned areas is presented. I.v.L.

N64-20438 National Aeronautical Lab., Bangalore (India)
AERODYNAMIC NOISE IN AIRCRAFT AND WIND TUNNELS
P. A. Irani and K. Sridhar Iya Aug. 1963 115 p refs
(SR-AE-2-63)

The following are discussed: (1) basic acoustic terms; (2) techniques of sound measurement; (3) jet noise; (4) other sources of noise—propeller, compressor, boundary layer, pulse jets, ram jets, rockets, propulsion systems, and sonic booms; (5) noise in wind tunnels; (6) acoustic materials; and (7) research programs—wind-tunnel noise, jet noise, and noise-suppression devices. R.T.K.

N64-20449 Hebrew U., Jerusalem (Israel) National Physical Lab. of Israel

A METHOD FOR DETERMINATION OF THE OPTICAL CONSTANTS OF THIN ABSORBING LAYERS Technical (Scientific) Note No. 4

J. Harris and H. Weinberger Aug. 1963 15 p refs

(Contract AF 61(052)-279)

(AFCRL-63-918; AD-289426)

A method was developed by which the optical constants of an absorbing layer on an absorbing base can be determined. The amplitude and phase of the light reflected by such a system are a known function of the parameters—complex refractive indices of film and substrate, film thickness, and angle of incidence. The equations are intractable and cannot be solved for the refractive index of the film. However, the use of a search technique for an electronic computer makes the reverse calculation possible. Given suitable starting values, one can quickly determine the film index giving rise to measured values of the intensity and phase difference of the reflected light. Application of this method to thin layers of "nickel black" shows that the layer is inhomogeneous, i.e., the complex refractive index varies with distance from the substrate. The consequences of inhomogeneity are discussed. Many of the values for the optical constants of thin films reported by other workers are in fact "average" values for inhomogeneous layers. Such values have only limited significance in predicting the optical behavior of inhomogeneous layers. Author

N64-20453 Massachusetts Inst. of Tech., Cambridge

RESEARCH IN MATERIALS SCIENCE AND ENGINEERING Annual Report No. 3, 1963-1964

R. A. Smith et al Apr. 1964 334 p refs

(Contracts ARPA-SD-90; DA-19-020-AMC-0231(X); Nonr-1841(10); AF 04(694)-305; AT(10-1)-1067 et al)

(AD-435880)

This survey of research covers the following areas: (1) chemical and solid-state physics; (2) electronic, magnetic, and optical properties of materials and applications to devices; (3) metallurgy and materials science; and (4) materials engineering. Also, the work of the following is presented: (1) the National Magnet Laboratory; (2) the Instrumentation Laboratory; and (3) the Lincoln Laboratory. I.v.L.

N64-20454 Uppsala U. (Sweden) Quantum Chemistry Group for Research in Atomic, Molecular and Solid-State Theory

STUDIES IN PERTURBATION THEORY. VIII: SEPARATION OF DIRAC EQUATION AND STUDY OF THE SPIN-ORBIT COUPLING AND FERMI CONTACT TERMS

Per-Olov Lowdin 1 Nov. 1963 32 p refs

(Contract AF 61(052)-701)

(TN-110; ARL-64-86; AD-437902)

The separation of the Dirac relativistic wave equation for one electron by means of the partitioning technique is studied. The operator aspects of the partitioning of the Dirac equation are studied in particular. In the numerical aspects, a complete orthonormal basis is introduced along with a matrix representation of the operators involved. A first partitioning leads to the separation of the Dirac equation into its large and small components, and a second partitioning takes out a subspace that contains only a single element of the orthonormal basis. The results of the investigation are used in a discussion of the hyperfine splitting hamiltonian for spin-orbit coupling and contact interactions. P.V.E.

N64-20460 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center

ON THE PROBLEM OF STEREOSCOPY IN THE BUBBLE CHAMBER. CORRECTION OF REFRACTION

D. Nyagu 8 Apr. 1964 16 p Transl. into ENGLISH from Rev. Phys. (Bucharest), v. 4, no. 2, 1959 p 235-243

(RSIC-157; AD-437959)

The image distortion of a certain object immersed in a transparent medium was studied while being photographed in air with a refraction coefficient n under a small angle of incidence ($i \sim 10°$). The study was performed from the viewpoint of an observer who used a projectional position in attempting to find the elements of a real image by measuring the geometric elements of the virtual image. Formulas of corrections are given for the coordinates of lengths and angles; these formulas can also be applied for correcting the radius of the curvature. The necessary corrections are significant and appear as functions of a point; therefore they cannot be expressed as a constant term. Thus, every case should be individually examined. However, with an appropriate section of measured elements, corrections that will considerably facilitate the calculations can be obtained with the aid of charts. I.v.L.

N64-20476 Mound Lab., Miamisburg, Ohio

REACTOR FUELS AND MATERIALS DEVELOPMENT PLUTONIUM RESEARCH: 1963 ANNUAL REPORT

L. J. Wittenberg and G. R. Grove 31 Dec. 1963 41 p refs

(Contract AT(33-1)-GEN-53)

(MLM-1184)

The Pu-Ce-Cu ternary phase diagram was completed. The Pu-Ce-Ni ternary system is being studied as a potential fuel system for the molten-Pu fast-breeder reactor concept. The study of the Pu-Ce binary phase diagram was completed. A terminal solubility of 20 ±2 a/o Pu in Y at 640° C was confirmed. Tiny, excellently formed, single crystals of two new structural forms of elemental B were prepared by passing B powder through the induction-coupled torch. The heat capacity of a Pu-Ce-Co eutectic alloy increased almost linearly with temperature. The relationship between viscosity and composition in the molten Pu-Fe binary alloy system was investigated from 0 to 13 a/o Fe. A new vacuum pycnometric device has extended the range of density measurement of molten metals to 1,200° C. Electromotive force measurements were made on a series of Cd-Bi alloys at 500° C. The induction-coupled plasma torch was used for producing high-density PuO_2 microspheres. Microspheres ranging in size from 50μ to 150μ diameter were produced from a mixture of 50 wt % PuO_2 and 50 wt % ThO_2. A glass which did not devitrify upon cooling was prepared using a high-temperature melting technique. I.v.L.

N64-20479 Columbia U., New York, N.Y. Liquid Metal Research Lab.

THERMOELECTRIC POTENTIALS OF MOLTEN AND REFRACTORY METALS

Charles F. Bonilla, Roland R. Kyi, Howard T. Drue (Hydrocarbon Res.), and Do-Ik Lee [1963] 21 p refs Presented at the 3rd Ann. (AEC) Conf. on High-Temp. Liquid-Metal Heat-Transfer Technol., Oak Ridge Natl. Lab., 4-6 Sep. 1963 Submitted for Publication

(Contract AT(30-1)-1042; Contract AT(30-1)-2660)

The total thermal EMF (electromotive force), thermo-EMF, or thermoelectric potential of a thermocouple, using metals A and B is designated E_{AB}, which is known as the Seebeck EMF. This paper reports the Seebeck potentials of sodium, potassium, rubidium, cesium, mercury vs platinum, and others. A.W.

N64-20499 Lockheed Missile and Space Co., Sunnyvale, Calif.
SUPERCONDUCTIVITY Annotated Bibliography, Jan.-Jun. 1963
Jack B. Goldmann, comp. Jul. 1963 118 p refs
(SRB-63-5; Rept. 6-90-63-79)

Current theory, properties, and applications of superconductors, as presented in the literature from January to June 1963 are covered in this annotated bibliography. The 242 entries, representing English and foreign language publications, are listed alphabetically by author. To facilitate location of specific items, author and subject indexes are included. Author

N64-20500 Lockheed Missiles and Space Co., Sunnyvale, Calif.
SUPERCONDUCTIVITY Annotated Bibliography, 1961-1962
Jack B. Goldmann, comp. Apr. 1963 206 p refs For Supplement 1, see N64-10405 01-25
(SB-63-33; Rept. 6-90-63-43)

This annotated bibliography on superconductivity covers the following subjects: (1) applications; (2) properties—conductivity, energy gap, magnetism, penetration depth, resistance, resonance, and ultrasonic effects; (3) theory; (4) thin-film preparation; and (5) transitions—critical current, critical field, critical temperature, intermediate state, and transition temperature. R.T.K.

N64-20504 Phillips Petroleum Co., Idaho Falls, Idaho Atomic Energy Div.
GAMMA-RAY SPECTROMETRY OF NEUTRON-DEFICIENT ISOTOPES Annual Progress Report
R. L. Heath and J. E. Cline 27 Mar. 1964 48 p refs
(Contract AT(10-1)-205)
(IDO-16969) OTS: $1.00

The objective of this program is to produce a set of pulse-height spectra representing the response of a standard gamma-ray scintillation spectrometer to radiations emitted in the decay of neutron-deficient nuclides. These spectra will be processed and presented in the same manner as those presently included in the "Scintillation Spectrometry Gamma-Ray Spectrum Catalogue," which originally contained only spectra of neutron-induced activities. The purpose of this collection of data is to provide reference material for experimenters applying the techniques of scintillation spectrometry to the measurement of accelerator produced isotopes. The methods employed for source production, the experimental equipment and measurement techniques are described in some detail. Spectra of over 20 neutron-deficient isotopes are presented in final form. Author

N64-20514 Los Alamos Scientific Lab., N. Mex.
LOS ALAMOS CRITICAL-MASS DATA
H. C. Paxton 6 May 1964 61 p refs
(Contract W-7405-ENG-36)
(LAMS-3067) OTS: $1.50

Numerous Los Alamos critical mass data have been published only as points on curves, frequently after adjustment to "standard" conditions (e.g., to uniform values of U^{235} enrichment and density), and usually without indication of reliability. Under these conditions, original data tend to become lost. It is the purpose of this compilation to retrieve original critical masses and to give some means of judging the quality of measurements. Indexes of accuracy are probable error (if it has been estimated), the maximum mass of fissile material used in the measurement, or the maximum central-source neutron multiplication attained. Author

N64-20520 General Electric Co., San Jose, Calif. Vallecotis Atomic Lab.
DESIGN AND FABRICATION OF FUEL RODS WITH STAINLESS-STEEL-LINED ZIRCALOY-2
C. J. Baroch Washington, Div. of Tech. Inform., 7 Feb. 1964 32 p refs
(Contract AT(04-3)-189)
(GEAP-4555) OTS: $0.75

Several intentionally defected fuel rods clad with Zircaloy-2 failed during irradiation in the Vallecitos Boiling Water Reactor (VBWR). A detailed investigation indicated that these failures were caused by a fluoride impurity in the UO_2 pellets reacting with the Zircaloy-2 in a steam environment. Several other fuel rod failures were observed, caused by gross hydriding of the Zircaloy clad. This hydriding was produced by the reaction between steam and Zircaloy-2 on the inside of defected fuel rods. The fluoride and hydride failures might have been avoided by lining the inside surface of the Zircaloy-2 cladding with a thin layer of stainless steel. As a consequence, an irradiation test was designed to evaluate the in-reactor performance of this type of cladding. Twenty 101.6-cm (40-in.) pieces of Zircaloy-2 tubing lined with a very thin layer (about 0.003 cm) of stainless steel were produced by coextrusion on a "best effort" basis. Seventeen of the 20 pieces of tubing were considered satisfactory for the production of fuel rods. Of these seventeen tubes, only 11 were reasonably free of blisters on the inside surface, internal and external roughness, or gross dimensional variations. The 17 fuel rods, containing UO_2 pellets of 95% ± 1 theoretical density, were fabricated using standard commercial fuel fabrication practice. Author

N64-20546 Columbia U., New York, N.Y.
APPLICATIONS OF A BALLOT THEOREM IN PHYSICS AND IN ORDER STATISTICS
Lajos Takács 2 Apr. 1964 16 p refs
(Contract Nonr-266(59))
(CU-43-64-NONR-266(59)MS; AD-436664)

This paper discusses: (1) the distribution of the number of gas molecules ionized by an electron passing through an electron tube; and (2) the distribution of the deviation of empirical and theoretical distribution functions when the sample size is a random variable having a Poisson distribution. Author

N64-20548* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
EFFECTS OF CONCENTRATION AND OF VIBRATIONAL RELAXATION ON THE INDUCTION PERIOD OF THE H_2-O_2 REACTION
F. E. Belles and M. R. Lauver Washington, NASA, 1964 26 p refs For Presentation at the 10th Intern. Symp. on Combust., Cambridge, Engl., 17–21 Aug. 1964
(NASA-TM-X-52022) OTS: $2.60 ph

The possibility that slow vibrational relaxation of O_2 or H_2 might affect the induction period of the high-temperature H_2–O_2 reaction is considered in terms of data from three different kinds of shock-tube experiments. The data cover a wide range of stoichiometry and temperature, and include observations in H_2–air, H_2–O_2–Ar, and H_2–O_2 mixtures. It was found that induction times, in excellent agreement with experiment, can be calculated by solving the differential rate equations based on the following simple kinetic scheme—an initiation reaction between molecular species plus the three usual chain-branching reactions. It is not necessary to invoke vibrational effects to obtain this agreement, but it is necessary to solve the problem without incorporating steady-state assumptions or limitation of stoichiometry. Thus, it is concluded that the existing data exhibit little or no effect of slow vibrational relaxation. In support of this conclusion, calculations are presented to show that the greatest possible effect of slow O_2 relaxation would, in fact, be a small one. The calculations were carried out by making the extreme assumption that all the activation energy of the slow chain-branching step must be supplied by the vibrational energy of O_2. I.v.L.

N64-20553 Frankford Arsenal, Philadelphia, Pa. Research and Development Group

THE MOMINERTOGRAPH FOR DETERMINING AXIAL AND TRANSVERSE MOMENTS OF INERTIA OF SOLIDS OF REVOLUTION

Winifred E. Green Feb. 1964 29 p
(FA-R-1708)

The mominertograph is a graph designed for rapid determination of the axial and transverse moments of inertia of a solid of revolution, using only its section drawing, and was successfully used by draftsmen having no training in any means of determination of moments of inertia. Author

N64-20580* Jet Propulsion Lab., Calif. Inst of Tech., Pasadena

EARTH RADIUS/KILOMETER CONVERSION FACTOR FOR THE LUNAR EPHEMERIS

Victor C. Clarke, Jr. Repr. from AIAA Journal, v. 2, no. 2, Feb. 1964 p 363–364 refs
(NASA Contract NAS7-100)
(NASA CR-56045; JPL-TR-32-489)

This paper discusses the determination of the conversion (or scale) factor to convert the lunar coordinates from earth radii to kilometers, the basic unit of measure used in calculations of precision simulations of lunar and interplanetary probe trajectories. The conversion factor must be computed from a relationship that is a function of the moon's mean motion and the gravitational constraints of the earth and moon. This relationship is developed and a value for the earth radius–kilometer conversion factor for the lunar Ephemeris is given. It is important to realize that the value of earth radius b is not the same as the actual radius of the Earth; it is merely the conversion factor and is used only for scaling the lunar Ephemeris from earth radii to kilometers. The value of the actual radius of the earth is taken to be R_E = 6378.165 km. IAA

N64-20589* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

PARTIAL WAVE THEORY OF DIATOMIC MOLECULES, II

A. Temkin and A. K. Bhatia Mar. 1964 41 p refs
(NASA TM X-51666; X-640-64-66) OTS: $4.60 ph

The method of expanding the wave function of diatomic molecules in a series of orbital angular momentum eigenfunctions (partial waves) is extended to two-electron homonuclear molecules. The angular momentum is a function of the Euler angles only; a symmetric choice of these angles is used, which greatly facilitates the description of the exchange character of the wave function. As a result, explicit equations for the three-dimensional "radial" functions can be derived for all the different magnetic parity, and for exchange states. For Σ states the partial wave sums only go over alternate values of the angular momentum giving rise to the expectation of an even more rapidly convergent series in these cases. Author

N64-20594* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

NONADIABATIC THEORY OF INELASTIC ELECTRON-HYDROGEN SCATTERING

H. L. Kyle Apr. 1964 79 p refs
(NASA TM X-51667; X-641-64-98) OTS: $7.60 ph

A brief history is given of the experimental measurements of the probability for the excitation of atomic hydrogen from the H(1s) state to the H(2s) state by electron impact. The experiments leave the excitation cross section, $\sigma_{1s\text{-}2s}$ uncertain by as much as a factor of 2 between 10.2 and 50 ev. A brief description of the close coupling approximation is given, and the desirability of an alternate method of approach is suggested. A formalism for the nonadiabatic treatment of the scattering of low energy s-wave electrons from atomic hydrogen was developed, and the zeroth order (angle-independent) approximation is explicity solved. The solution was effected by expanding the wave function in terms of separable solutions. The elastic cross sections, $\sigma_{1s\text{-}1s}$, are within 1% of the close coupling results in the triplet case, but are about 20% greater in the singlet case. The inelastic ross sections, $\sigma_{1s\text{-}2s}$, are reduced about 20% in the triplet case and 20% to 40% in the singlet case relative to the close coupling results. Author

N64-20595* National Bureau of Standards, Boulder, Colo. Cryogenic Engineering Lab.

SECOND AND THIRD VIRIAL COEFFICIENTS FOR HYDROGEN

R. D. Goodwin, D. E. Diller, H. M. Roder, and L. A. Weber Repr. from J. Res. Natl. Bur. Std., A., v. 68A, no. 1, Jan.–Feb. 1964 p 121–126 refs
(NASA Order R-45)

Second and third virial coefficients for parahydrogen were derived from closely spaced PVT data from 24° to 100° K. They are in good agreement at 100° K with published data for normal hydrogen. Analytical representations of the combined data from about 20° to 423° K are presented that may be useful in computation of thermodynamic functions of the gas. These formulas are related to those resulting from the use of the Lennard–Jones potential. Author

N64-20596* National Bureau of Standards, Washington, D.C.

VACUUM ULTRAVIOLET ABSORPTION SPECTRA OF OXYGEN IN LIQUID AND CRYSTALLINE ARGON AND NITROGEN

Arnold M. Bass and H. P. Broida Repr. from J. Mol. Spectr., v. 12, no. 3, Mar. 1964 p 221–230 refs Previously published as a preprint; See N63-14224 09-07
(NASA Order R-64)

The ultraviolet absorption spectra of oxygen were observed in liquid and solid media at low temperature. By freezing slowly from the liquid phase, samples of crystalline argon and nitrogen were prepared with added amounts of oxygen ranging

between 0.01% and 10%. The spectra were recorded photoelectrically, through fused silica windows, over the wavelength range from 1,750 to 2,900 A. The Schumann–Runge bands of oxygen ($B\ ^3\Sigma_u^- \leftarrow X\ ^3\Sigma_g^-$, 1,750 to 2,000 A) were observed in solid and liquid mixtures of oxygen in argon or nitrogen at concentrations less than 5%, over the temperature range 60° to 90° K. The bands are broad, with half-intensity width of 150 to 550 cm^{-1} and show no structure. The bands show a slight shading toward the violet in contrast to the bands in the gas phase, and are displaced toward lower frequencies by 50 to 400 cm^{-1} as compared with the positions in the gas phase; these shifts are partly dependent upon temperature. The changes in position or shape of the bands between liquid and solid or between argon and nitrogen media are remarkably small. At concentration of oxygen above 5%, the Herzberg bands of oxygen ($A\ ^3\Sigma_u^+ \leftarrow X\ ^3\Sigma_g^-$) were observed in the region 2,400 to 3,000 A. These bands are also broad (200 to 600 cm^{-1}) and show some partially resolved structure. No differences were observed for changes either in temperature or matrix material. Author

N64-20607* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

ANALYTICAL STUDY OF THE WORK FUNCTION CHARACTERISTICS OF A METAL IMMERSED IN CESIUM VAPOR – SURFACE CONTRIBUTION

Keung P. Luke 1964 6 p refs Presented at the 24th Ann. Conf. on Phys. Electron., Cambridge, Mass., 25–27 Mar. 1964

(NASA TM X-52026) OTS: $1.10 ph

In an effort to derive an analytical expression to represent the work-function variation as a function of the ratio of surface to cesium temperature, it was found that the metal surface plays a far more important role in the adsorption process than that attributed to it in the literature. This report shows that, because of the presence of the metal surface, it is necessary to consider the effective electric field acting on each adsorbed particle, the effective polarizability of each adsorbed particle, and a new expression for the variation in atom desorption energy with gas coverage. I.v.L.

N64-20621 India. Dept. of Atomic Energy, Bombay Health Physics Div.

MEASUREMENTS ON THE ENVIRONMENTAL RADIOACTIVITY IN INDIA FROM NUCLEAR WEAPON TESTS DATA COLLECTED DURING 1962-63

K. G. Vohra et al Dec. 1963 66 p refs

(AEET-AM-39; Suppl. to AEET-AM-26)

Tables are presented that include complete fallout data for the year 1962 and some data on Cs-137, and other gamma emitting isotopes for the year 1963. Information is included on the strontium-90 concentrations in milk and food. R.T.K.

N64-20623 Kyoto U. (Japan) Research Inst. for Fundamental Physics

AN EXTENDED BOSON APPROXIMATION IN THE THEORY OF NUCLEAR STRUCTURE

Ken-ji Hara Mar. 1964 34 p refs Submitted for Publication

(RIFP-33)

The conventional Boson Approximation is extended to take account of the ground state correlation properly. The correlated nature of the true (or Boson) ground state makes the eigenvalue equations nonlinear. However, it is possible to know some general features of the theory in comparison with the conventional one without use of any solutions. Further, several characteristics of the present theory are discussed. Author

N64-20635 Hanford Atomic Products Operation, Richland, Wash.

TWO CROSS SECTION LIBRARIES FOR USE WITH MAC SHIELDING CODE

J. Greenborg Jan. 1964 119 p refs

(Contract AT(45-1)-1350)

(HW-73381 Sup. 1) OTS: $2.25

Two tabulations of cross sections and group constants for 77 elements and seven isotopes are presented in format arranged for direct input to MAC code problems. The absorption, elastic scattering, and inelastic scattering neutron cross sections are given in 15 and 31 group energy–lethargy structures. The additional group constants are common to both neutron libraries and include gamma ray mass attenuation coefficients (7 group), energy dependent removal cross sections (18 group), neutron and gamma ray flux to dose conversion factors, Taylor buildup factors, and the gamma rays produced per neutron capture per nuclide. The energy–lethargy structure of the 31 group library is of uneven lethargy intervals and was chosen to adequately define the energy and spatial distribution of neutron flux in power reactor shields composed of large volumes of concrete with thick regions of iron. Equal lethargy intervals were chosen for the 15 group library to provide cross sections suitable for preliminary investigations of many shield materials and configurations. The 15 group library reduces computer time approximately 38%. Discussions of the methods used to calculate and estimate the group averaged neutron cross sections and constants are included. Author

N64-20641* Smithsonian Astrophysical Observatory, Cambridge, Mass.

LONG-PERIOD EFFECTS IN NEARLY COMMENSURABLE CASES OF THE RESTRICTED THREE-BODY PROBLEM

Joachim Schubart 15 Apr. 1964 38 p refs

(NASA Grant NsG-87/60)

(NASA CR-56079; SAO Special Rept.-149) OTS: $3.60 ph

The long-period effects in nearly commensurable cases of the restricted three-body problem were studied according to the ideas of Poincaré. The secular and critical terms of the disturbing function were isolated by a numerical averaging process, using an IBM-7094 computer. Stability is found for all real asteroid orbits corresponding to the cases treated here. Periods of the variations are given for some forms of planar motion. Planar and nonplanar periodic solutions are indicated by the theory. No evidence is found for a disintegration of the Trojan and Hilda groups of asteroids. Brouwer's explanation of differences between the Hecuba and Hilda commensurabilities is supported. Author

N64-20653 Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.

YANKEE CORE EVALUATION PROGRAM Quarterly Progress Report, Period Ending Sep. 30, 1963

L. Chajson Oct. 1963 167 p refs

(Contract AT(30-1)-3017)

(WCAP-6056)

A description is given of the completion of the first phase of the underwater examination and disassembly of the Yankee Core I irradiated fuel assembly; the status and results of the hot

cell work and laboratory analyses performed to date are given; and progress on the evaluation of data and the revision of design methods is included. All activities related to the examination of Yankee fuel assemblies and control rods are discussed. Details of the Yankee Core evaluation and the revision of nuclear design methods are included. R.T.K.

N64-20661 Joint Publications Research Service, Washington, D.C.

ELECTRON MAGNETIC RESONANCE SPECTRA OF V_2O_5 TYPE OF CATALYST

Kuang-chih Hsu, Su-ming Ch'en, and Yu-ch'i T'ang *In its* Transl. on Communist China's Sci. and Technol., no. 82 12 May 1964 p 62–69 refs Transl. into ENGLISH from K'o-hsueh T'ung-pao (Peiping), no. 2, 1964 p 157–160 (See N64-20657 13-01) OTS: $2.25

The K_2SO_4, $KHSO_4$, and $K_2S_2O_7$ give no resonance absorption whereas V_2O_5 heated to 500° C does give a resonance signal. In the V_2O_5-$K_2S_2O_7$ system, when the V_2O_5 content is equal to or less than 30% (mole), the resonance spectra have clearly distinguishable 13 fine structures; when the V_2O_5 content is increased to 50% (mole), the spectra become a broad line. In the V_2O_5-$KHSO_4$ system, when the V_2O_5 content is less than 17.7% (mole), the resonance spectra also have a clear fine structure and are similar to the V_2O_5-$K_2S_2O_7$; above 17.7% (mole) content of V_2O_5, the fine structure in the spectra cannot be seen. In the V_2O_5-K_2SO_4 system, when the V_2O_5 content exceeds 20% (mole), the resonance spectra show a clear fine structure, and the shape is similar to the V_2O_5-$KHSO_4$ and V_2O_5-$K_2S_2O_7$ systems; when the V_2O_5 content is less than 20% (mole), the spectra become unclear. From comparison of the fine structure numbers and line shapes of the three resonance spectra of the systems V_2O_5-K_2SO_4, V_2O_5-$KHSO_4$, and V_2O_5-$K_2S_2O_7$, it is concluded that the spectra are due to the same 4-valent vanadium ion: VO^{++}. P.V.E.

N64-20662 Joint Publications Research Service, Washington, D.C.

THE MAGNETIC RESONANCE OF AROMATIC HYDROCARBON CARBONIUM IONS. PART I. CARBONIUM ION BASE OF DIFFERENT ISOMERS OF TERPHENYL

Tzu-ying Chu, Kuei-hsiang Fu, Chia-lai P'an, Huai-yu Sheng, and Jung-chieh Hu *In its* Transl. on Communist China's Sci. and Technol., no. 82 12 May 1964 p 70–77 refs Transl. into ENGLISH from K'o-hsueh T'ung-pao (Peiping), no. 2, 1964 p 160–162 (See N64-20657 13-01) OTS: $2.25

The paramagnetic resonance spectrum of the diphenyl benzene in its various forms is discussed. The ortho- and para-diphenyl benzene carbonium ion has 35 spectral lines, and the meta-diphenyl benzene has 17 sets of 5 lines. Considering the material itself, the spin density of para-diphenyl benzene carbonium ion of the various carbon atoms agrees with the calculation for the Huckel molecular orbital methods; the unpaired electrons among the 3 benzene rings communicate. The electron paramagnetic resonance spectra indicate that ortho- and para-diphenyl benzene carbonium ion has a similar electron spin density. The protons and unpaired electrons at the various positions are also similar. The ortho isomer has space effect so that the two benzene rings at the edge have decreased electrophilic power. Meta-diphenyl benzene carbonium ion has an entirely different spectrum indicating that its spin density is also different. From the super fine structure of the spectrum, it is concluded that the ortho- and para-protons on the three benzene rings make contributions (e.g., three benzene rings can have at most a small inclination, so that the unpaired electrons can be transferred from one benzene ring to another ring). P.V.E.

N64-20664 Stanford U., Calif. Stanford Linear Accelerator Center

MISALIGNMENT AND QUADRUPOLE ERROR EFFECTS IN A FOCUSING SYSTEM FOR THE TWO-MILE ACCELERATOR

R. H. Helm Jan. 1963 58 p refs
(Contract AT(04-3)-400)
(SLAC-11) OTS: $1.50

Various misalignments and errors in the strengths and spacing of the quadrupoles are discussed as follows: (1) displacement of the accelerator between the 40-ft support points; (2) short-range misalignments; in particular, random displacements of the support points from the mean reference axis (a smooth curve that represents the local average position of the accelerator axis); (3) intermediate- and long-range misalignments—random displacements of the support system that are correlated over a finite range; isolated discontinuities, such as bends or displaced regions; and constant curvature; (4) rotational errors in which the quadrupoles have small random rotations about the reference axis; and (5) errors and periodic variations in the quadrupole strengths and spacing. Numerical examples are given only for a particular focusing system, a system of thin-lens, uniformly spaced quadrupoles, but the general formulation will be suitable for other types of systems. Each of the various perturbations is treated independently, as if all others were absent because the equations of motion are essentially linear and superposition applies. I.v.L

N64-20667 Argonne National Lab., Ill. Reactor Engineering Div.

FARET EXPERIMENTAL PROGRAM Interim Report

A. Smaardyk, T. R. Bump, J. Handwerk, W. J. Kann, E. L. Martinec et al Apr. 1963 84 p refs
(Contract W-31-109-ENG-38)
(ANL-6708)

The Fast Reactor Test (FARET) program is part of the United States Fast Reactor Program directed toward the demonstration of breeder reactors that are essential to the long-range goal of utilizing fertile fuels. The FARET capability, program objectives, and design considerations are discussed. Experiments on reactivity effects of fuel temperatures, physics irradiation, engineering irradiation, and coolant chemistry are described. Materials development and program evaluation and review technique scheduling are presented. R.T.K.

N64-20668 Atomics International, Canoga Park, Calif.

HYDRAULIC CHARACTERISTICS OF HNPF 8-ROD FUEL ELEMENT

R. J. Begley 15 Aug. 1963 25 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-7475) OTS: $0.50

Pressure drop and vibration characteristics were determined for an 8-rod fuel element model of the design intended for use with uranium carbide (UC) in the Hallam Nuclear Power Facility (HNPF). Measurements with water as the test fluid were converted to equivalent values for sodium, the HNPF coolant, using the principles of dimensional similitude. Initially UC elements will be included in an HNPF core loading comprised primarily of 19-rod U-Mo fuel elements. In this core loading, the UC fuel element requires 17.5 lb/sec of sodium coolant at a core pressure drop of 11 psi. The measured fuel element pressure drop ranged from 0.27 to 5.6 psi over the sodium flow range from 3.5 to 17.4 lb/sec. The existing HNPF variable orifice can adjust flow for this fuel element over the range from 5.7 to 21 lb/sec at a core pressure drop of 11 psi. No significant vibration of the fuel rods was induced by the flow of water. Author

N64-20690* Arkansas U., Little Rock Graduate Inst. of Tech.
BASIC EXPERIMENTAL RESEARCH LEADING TO IMPROVED COLD ELECTRON SOURCES AND NEW TYPES OF VELOCITY FILTER MASS SPECTROMETERS Final Report
M. K. Testerman et al 10 Apr. 1964 33 p refs
(Grant NsG-153-61)
(NASA CR-56103)

The Lissajous mass spectrometer, with many theoretical advantages over other spectrometers for space research, was investigated. It is a velocity filter device that derives its mass separation ability from the phase difference in ions traversing three stages of electrostatic deflection. The chief advantage of the Lissajous mass spectrometer over radiofrequency types is its long duty cycle. This spectrometer has no low-mass discrimination, as does the Bennett tube. Grids, one of the major causes of sensitivity loss in the Bennett tube, were eliminated. Also, various designs of cold electron sources capable of mass spectrometric applications are discussed. R.T.K.

N64-20711 Brookhaven National Lab., Upton, N.Y.
THE NUCLEAR REACTOR COMES OF AGE Brookhaven Lecture Series No. 31
Jack Chernick 13 Nov. 1963 20 p refs
(BNL-838(T-329)) OTS: $0.50

Nuclear reactors are discussed in general, and some of their uses are outlined. The achievement of the first chain reaction is described. The present applications and future importance of the nuclear reactor are discussed, and Brookhaven's role in these developments is detailed. R.T.K.

N64-20716 Atomic Energy Commission, Washington, D.C. Div. of Technical Information
PEACEFUL USES FOR NUCLEAR EXPLOSIVES, A SELECTED ANNOTATED BIBLIOGRAPHY
Hugh E. Voress, Richard J. Smith, and Carl R. Gerber, comp. Jan. 1963 47 p refs
(TID-3522(Rev. 6)) OTS: $1.25

This bibliography presents 215 annotated references concerning the use of nuclear explosives for peaceful purposes, such as isotope production, oil recovery, water management, and the excavation of harbors and canals. I.v.L.

N64-20720 Minneapolis-Honeywell Regulator Co., Minn. Military Products Group Research Lab.
HOLLOW SUPERCONDUCTORS IN A MAGNETIC FIELD Translation No. 513
Lun Dao-Shui and G. F. Zharkov Apr. 1964 17 p refs Transl. into ENGLISH from Zh. Eksperim. i Teor. Fiz. (Moscow), v. 44, no. 6, 1963 p 2122–2130

Formulas were obtained within the framework of the Ginzburg–Landau theory of superconductivity that described the behavior in a magnetic field of superconducting samples in the form of a hollow sphere or a hollow cylinder. The critical magnetic fields of such samples were found. The limits of possible "superheating" or "supercooling" were determined. Destruction of the superconductivity of a hollow cylinder by a current was also considered. Author

N64-20723* MB Associates, Walnut Creek, Calif.
FEASIBILITY STUDY FOR DEVELOPMENT OF A HYPERVELOCITY GUN
D. E. Brast and D. R. Sawle 27 Mar. 1964 98 p
(NASA Contract NAS3-1924)
(NASA CR-54028; MB-R-64/21) OTS: $8.60 ph

By means of a rail-type MHD accelerator, a 2.4 mg nylon ball was accelerated to 6.0 km/sec and an 8 mg nylon ball to 3.7 km/sec. Measurements of time vs projectile position in the accelerator were made by means of magnetic flux loops. These data were explained by assuming mass input from the rails due to sputtering. Under this assumption, the data led to a value of 4.6 copper atoms sputtered per electron. A 142-microfarad, 28-kilojoule condenser bank was the electrical source in the experiments. A high explosive MHD generator was developed for possible future use with the accelerator. Author

N64-20733* Bolt, Beranek, and Newman, Inc., Cambridge
COUPLING OF SOUND AND PANEL VIBRATION BELOW THE CRITICAL FREQUENCY
P. W. Smith, Jr. [1962] 21 p refs Submitted for Publication
(NASA Contract NASw-788)
(NASA CR-53605) OTS: $2.60 ph

Prior analysis has shown that the sound power radiated from reverberant vibration of a simply supported panel is proportional to the length of the panel's perimeter when the frequency is below the critical frequency. A simple physical interpretation was made in terms of the mode shape of resonant modes. Other analyses for power radiation from a single straight boundary on an infinite panel indicated that twice as much power radiates from a clamped edge as from the simply supported edge, the spatial mean square velocity being held constant. It is shown here that the increased radiation from clamped edges is also predictable from simple considerations of the mode shape. Author

N64-20735* Hawaii Inst. of Geophysics, Honolulu
ON THE USE OF A PILE-OF-PLATES POLARIZER; THE TRANSMITTED COMPONENT
J. L. Weinberg [1963] 13 p refs Submitted for Publication
(NASA Grant NsG-135-61)
(NASA CR-55526) OTS: $1.60 ph

Formulas for the transmitted component of a pile-of-plates polarizer are derived in terms of the angle of incidence, the index of refraction, and the number of (transparent) plates for singly and multiply reflected rays. Numerical results are discussed for 1, 2, 5, and 10 plates and for indices of refraction of 1.5170, 1.5180, 1.5725, and 1.6210. Author

N64-20738* Rice U., Houston, Tex.
A NOTE ON THE AHARONOV-BOHM PARADOX
G. T. Trammell [1961] 9 p refs
(NASA Grant NsG-6-59)
(NASA CR-53183) OTS: $1.10 ph

Even in the classical limit, the behavior of a charged particle interacting with a stationary current distribution exhibits paradoxical behavior; this results from the inequality of action and reaction forces. The vector potential term appearing in the expression for the canonical momenta represents the electromagnetic field momentum. Author

24 PHYSICS, PLASMA

Includes fusion; and magnetohydrodynamics. *For related information see*: 05 Astronomy and Astrophysics; 23 Physics, General; and 25 Physics, Solid-State.

N64-20025 Illinois U., Urbana Engineering Experiment Station
MOLECULAR STORAGE AND TRANSFER OF ELECTROMAGNETIC ENERGY IN GASEOUS PLASMAS Final Report

T. C. Marshall, R. A. Kawcyn, E. A. Mc Lennan, J. Berlande, and L. Goldstein Griffiss AFB, N.Y., RADC, Apr. 1964 114 p refs
(Contract AF 30(602)-2650)
(RADC-TDR-63-275; AD-438419)

A laboratory study of the generation and recombination of atoms is presented. The background information consists of a discussion of various methods for producing atoms of nitrogen, oxygen, and hydrogen by electrical discharges, with primary emphasis placed on the use of intense microwave electric fields. Also included is an enumeration of methods for detecting atoms. Emphasis is placed on the use of electron spin resonance techniques, with mention made of the use of heated wire filaments and chemical titration with gases. Results are presented of investigations into the various loss mechanisms and reactions that affect the experimental use of atoms. These losses are of three types: (1) volume recombination in the bulk of the gas; (2) surface recombinations; and (3) electronic processes in the volume of the gas. Author

N64-20036 ARO, Inc., Arnold Air Force Station, Tenn. Propulsion Wind Tunnel Facility
SOME CONSIDERATIONS IN THE DESIGN OF WATER-COOLED NOZZLE THROAT SECTIONS FOR HIGH TEMPERATURE, HIGH PRESSURE OPERATION
Henry F. Lewis and Dennis D. Horn Arnold Eng. Develop. Center, Apr. 1964 72 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-51; AD-437973)

The calibration of a Linde N-4000 electric arc heater necessitated having a nozzle (restrictor) capable of repeated operation at high pressures and temperatures. The theoretical and experimental bases used in the design of the water-cooled nozzle are presented. Included are the procedures to determine the nozzle liner material, liner thickness, water flow requirements, and optimum wall operating temperatures. Two nozzle liners designed for 100 atm total pressure and 5,000 Btu/ft^2-sec throat heat flux were operated without failure for a total of about 80 minutes, the longest sustained run being 6.0 minutes. A maximum total pressure of 55 atm was reached with a throat heat flux estimated to be in the range of 3,000 to 3,500 Btu/ft^2-sec. Author

N64-20086 Stanford Research Inst., Menlo Park, Calif.
PRELIMINARY RESULTS ON FAST LUMINOUS FRONTS IN ELECTROMAGNETIC SHOCK TUBES Technical Report 17
R. A. Nelson Nov. 1963 13 p refs
(ARPA SD-103; ARPA Order 281-62)
(AD-437190)

Preliminary results of a theoretical study of precursor effects in electromagnetic shock tubes are presented. In particular, an examination is made of the theories of fast luminous fronts observed to precede shock waves in such shock tubes. Errors in a theory by Paxton and Fowler are indicated. Author

N64-20091 Maryland U., College Park
A MAGNETIC COMPRESSION EXPERIMENT FOR THE STUDY OF SHOCK WAVE STRUCTURES Scientific Report No. 2
G. Goldenbaum and E. K. Hintz Dec. 1963 21 p refs
(Contract AF 19(628)-269)
(AFCRL-64-293; AD-437944)

The construction of the experimental apparatus for the investigation of the structure of hydromagnetic shock waves was completed. By using a technique developed in connection with "theta-pinch" experiments, a cylindrical plasma was produced with an internal magnetic field of variable magnitude. A fast rising external magnetic field was applied driving the plasma toward the axis thereby generating cylindrical shock waves. The density and the composition of the initial plasma, the magnitude of the internal magnetic field, the rise time, and the maximum amplitude of the compressing field can be varied over a wide range. It is possible to choose the parameters so that the ion mean free path in the shocked plasma is large compared to the ion cyclotron radius. With an initial density of 10^{15} particles cm^{-3} and an initial magnetic field of 350 gauss, the application of a fast magnetic field pulse with a peak field of 3,500 gauss and a rise time of 0.2μsec causes a shock wave in the plasma having a velocity of 15cm/μsec; the proton mean free path should be large compared to the cyclotron radius. Author

N64-20101 Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics
LARGE-SIGNAL BEHAVIOR OF A PARAMETRIC MAGNETOGASDYNAMIC GENERATOR
Arthur T. Lewis (Ph.D. Thesis) Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Nov. 1963 106 p refs
(Contract AF 33(616)-7624)
(RTD-TDR-63-4132; AD-438959)

The large-signal behavior of a parametric magnetogasdynamic generator consisting of a cylindrical coil with batches of highly conducting plasma traveling along the coil axis is considered. The purpose of this work is to determine: (1) whether the requirements for the conductivity and velocity of the gas found for small-signal behavior are relaxed because of enhancing mechanism during interaction; (2) what fraction of the gas power could be extracted as useful electrical power, that is, the overall generator efficiency; (3) how the interaction between the field and the gas leads to gas behavior that limits the growth of the parametric oscillations so that a stable operating point is reached; (4) an estimate of the minimum size and power of a generator with present technology; and (5) the factors that control the scaling of the parametric generator. An analysis is presented for the small-signal behavior to establish the important parameters and provide a basis of comparison for the large-signal behavior. A criterion is established for determining the steady-state operating point in terms of the electrical terminal behavior. The gas-flow interaction with the field is analyzed. Author

N64-20107 Air Force Cambridge Research Labs., Bedford, Mass. Space Physics Lab.
NOTES ON HYDROMAGNETICS AND PLASMA PHYSICS
R. L. Caravallano and J. F. Mc Clay Dec. 1963 113 p refs
(AFCRL-63-907; AD-437636)

This set of notes was compiled in order to assist the geophysicist about to enter into the realm of space physics for the first time. Subjects such as properties of a neutral conducting fluid, equations of plasma physics, hydromagnetic waves, motion of charged particles in certain force fields, and adiabatic invariants are treated. Prerequisites for understanding the material are a working knowledge of Maxwell's equations, some familiarity with Lorentz transformations, and the basic principles of classical mechanics. Author

N64-20112 General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
RECOMBINATION AND ATTACHMENT IN IONIZED GASES Final Report, May 2, 1960–Jul. 31, 1963

V. A. J. van Lint, J. Parez, M. E. Wyatt, and D. K. Nichols Kirtland AFB, N. Mex., Res. and Technol. Div., Dec. 1963 201 p refs
(Contract AF 29(601)-2779)
(RTD-TDR-63-3076; AD-428434)

Experiments have been performed to measure the coefficients for electron attachment, electron–ion recombination, electron–molecule collisions, and ion–ion recombination in important atmospheric gases and atmospheric impurities. These experiments were performed by observing the rate of disappearance of electrons (or ions) in the afterglow of a pulse of ionization produced by high energy electrons transversing the gas sample. Most of the diagnostic measurements were performed by observing the phase shift and attenuation of an X-band microwave propagated through the ionized gas. Some experiments have been performed with a 300 mc resonating cavity that is sensitive enough to detect the effect of ions in the afterglow after the electrons have been attached. The most significant results of these experiments are: (1) three-body attachment rate in O_2 and NO_2 as stabilized by O_2, NO_2, or N_2; (2) electron–ion recombination coefficient in O_2, N_2, and NO; and (3) electron scattering frequency and thermalization rates in O_2, N_2, He, Ne, and Ar. Author

N64-20115 California U., Berkeley Electronics Research Lab.
RESEARCH ON PHYSICAL PHENOMENA AFFECTING THE CHARACTERISTICS OF ELECTRONIC COMPONENTS [Final Report, 1 Oct. 1961-30 Sep. 1963]
C.K. Birdsall, S. A. Colgate, A. J. Lichtenberg, and A. W. Trivelpiece 30 Nov. 1963 24 p refs
(Contract AF 33(657)-7614)
(Series 60, Issue 486; RTD-TDR-63-4143)

Two mirror experiments are described. The first was a two-stage magnetic-mirror compression experiment in which low-energy, low-density plasma from a hydride source was injected and trapped in a low-flux density magnetic-mirror field; the second experiment was a two-stage magnetic-mirror compression experiment in which the plasma was formed in a coaxial crossed-field configuration and transferred to a second high-compression region. To provide the high-magnetic flux densities required for the magnetic-mirror compression experiments, a high-energy capacitor bank, together with the necessary electronic-control circuitry to switch various sections of the bank as required for the experiment was constructed and is operational. Microwave interferometers for electron-density measurements were operated at 3-cm and 8-mm wavelength, corresponding to plasma cutoff densities of 1.2×10^{12}, and 1.7×10^{13} electrons/cm^3. The high-temperature plasma results are reported in detail, and the published results of the two-year period, covered in detail in technical or memoranda reports, are summarized. Most of the reports refer to electron-beam microwave-tube type projects. R.T.K.

N64-20124 Air Force Systems Command, Wright-Patterson AFB, Ohio Aeronautical Systems Div.
A GLOW DISCHARGE PLASMA GENERATOR
George W. Loptien Mar. 1964 53 p refs
(ASD-TDR-63-835; AD-437783)

This investigation was to determine the capabilities and operating characteristics of a small-scale research facility using a d.c. discharge as the energy source. The goal of the program is to develop a "cold" plasma source suitable for use with a crossed field accelerator. The apparatus consists of a continuous low temperature electric discharge, the products of which are expanded through a supersonic nozzle into a low pressure chamber. Air was used as the test gas. The apparatus may be operated continuously. The electrical characteristics of the discharge were determined from voltage, current and mass flow measurements, and brief impact pressure, current collection, and stagnation temperature measurements were made in the nozzle effluent. The use of a d.c. glow discharge type plasma generator for producing a "cold" plasma appears feasible. Author

N64-20129 California Inst. of Tech., Pasadena Antenna Lab.
MICROWAVE INTERACTION WITH BOUNDED GYROELECTRIC PLASMAS Technical Report No. 31
Elliott R. Nagelberg Apr. 1964 110 p refs
(Contract AF 49(638)-1266)
(AD-437672)

The interaction of microwaves with gyroelectric plasmas of finite extent, particularly those having cylindrical or spherical boundaries is investigated theoretically. Within the latter class of problems, only those involving the axially magnetized column with circular cross section are amenable to rigorous analysis. It is found that one of the important effects of the anisotropy is to induce changes in the polarization of the scattered field resulting from interaction with an obliquely incident plane wave. As a means of solving problems that involve uniform but arbitrarily directed magnetization, the perturbation theory of microwave interaction is developed in which the static magnetic field is regarded as a small perturbation of the isotropic plasma. The field equations are derived for all orders, but only those of first order, linear in the magnitude of the static magnetic field, are solved. The first-order theory is then applied to cylindrical and spherical problems. Also considered is the problem of a magnetic dipole radiating from within a weakly magnetized plasma sphere. Author

N64-20139 General Dynamics/Astronautics, San Diego, Calif. Space Science Lab.
PRELIMINARY HYPERVELOCITY WAKE BRIGHTNESS TEMPERATURE MEASUREMENTS
William J. Hooker Oct. 1963 15 p refs
(Contract DA-04-495-ORD-3383(Z); Proj. Defender)
(GDA63-0506; AD-434999)

Experimental measurements of the brightness temperature of wakes of 20-mm-diam-blunt bodies fired at 20,000 fps are described. The measurements were obtained on the 20-mm shock-heated light gas gun range. The measured sodium spectral line reversal brightness temperatures are related to the (peak) centerline temperatures calculated for a gaussian temperature and sodium atom concentration profile for both Doppler and Lorentz spectral line contours. Author

N64-20172 Stanford Research Inst., Menlo Park, Calif. Molecular Physics Dept.
A LOW ENERGY ALKALI ATOM BEAM SOURCE Technical Report No. 19
Donald C. Lorents and Graham Black Feb. 1964 29 p refs
(ARPA Order 281-62; ARPA-SD-103)
(AD-437153)

A method of obtaining beams of alkali atoms in the ev energy range was developed. The energy range and beam intensities may be used for studying ionizing reactions in reentry physics. Lithium ions emitted thermally from a β-eucryptite source were accelerated and focused into a ribbon beam. Beams with current densities near the theoretical space

charge limit were attained. The β-eucryptite source emits impurity ions of Na and K, but above 1,000° C, the impurity ions comprise less than 0.2% of the beam. The ion beam traverses at right angles a high-density collimated thermal lithium vapor beam issuing from an oven. Neutralization of the ion beam occurs by charge transfer interactions between the ions and vapor atoms. The vapor beam is frozen out on the cooled walls of the chamber. Neutral beam intensities range from about 1×10^{-10} amp (ion equivalent) at 5 ev to about 2×10^{-9} amp at 30 ev. The measured ion beam densities and conversion efficiencies demonstrate that neutral beam densities of the order of 10^{-9} amp/cm^2 (ion equivalent) can be obtained at energies below 10 ev. The total cross section for charge transfer between lithium ions and atoms was measured for relative energies of 14 ev to 1,000 ev. The slow ions from charge transfer interactions were collected in a negatively biased cage surrounding the intersection volume of the two beams. The vapor beam density for the absolute cross section measurements was obtained by a titration technique. Author

N64-20174 Ohio State U. Research Foundation, Columbus Antenna Lab.
OBLIQUE INCIDENCE ON PLANE BOUNDARY BETWEEN TWO GENERAL GYROTROPIC PLASMA MEDIA Scientific Report No. 22
H. Unz 15 Oct. 1963 38 p refs
(Contract AF 19(604)-7270)
(AFCRL-64-45; Rept. 1116-34; AD-437939)

The problem of a characteristic electromagnetic wave incident, obliquely on a plane boundary between two different gyrotropic plasma media, is solved. Two characteristic transmitted waves and two characteristic reflected waves will result. The corresponding reflection and transmission coefficients were evaluated. The particular degenerate cases of free space–gyrotropic medium, gyrotropic medium–free space, and gyrotropic medium–perfect conductor are solved in the appendices. Author

N64-20193* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
VOLUME ION PRODUCTION IN A TENUOUS HELIUM PLASMA
Ronald J. Sovie and Barry M. Klein Washington, NASA, May 1964 24 p refs
(NASA TN D-2324) OTS: $0.75

A theoretical calculation of the energy required for volume ion production has been made for a partially ionized helium plasma in which a Maxwellian distribution of electron energies prevails. Inelastic electron–atom collisions that result in excitation of atomic energy levels are the only loss mechanisms considered. The energy is computed by considering the relative rates for the competing process of excitation and ionization. The results show that the energy required for volume ion production decreases sharply from 78 to 43.5 ev per ion as the electron kinetic temperature increases from 6 to 60 ev. Beyond 60 ev the energy required decreases slowly to 40.8 ev per ion at an electron kinetic temperature of 100 ev. The results have also been used to evaluate the ion production rate and the power consumed in ion production for a steady-state plasma as a function of electron kinetic temperature. Author

N64-20274 McDonnell Aircraft Corp., St. Louis, Mo. Space and Missile Engineering Div.
ANALYSIS OF PLASMA GENERATORS Final Report
D. R. Hesser 16 Jan. 1964 232 p refs
(Contract AF 33(657)-11464)
(A-220; RTD-TDR-63-4222; AD-428310)

This report is an evaluation of existing plasma generators in terms of their capability for providing experimental data, useful to the determination of telemetry plasma sheath interactions, and the formulation of techniques for testing telemetry under simulated reentry conditions. The plasma characteristics of typical reentry plasmas were calculated to delineate the range of parameters to be simulated. Electromagnetic wave propagation and antenna effects were reviewed to establish the parameters to be studied in the experimental tests. The plasma generators studied were: radiofrequency plasma generators, low-density plasma generators, glow discharge tubes, shock tubes, electromagnetic shock tubes, hypervelocity impulse tunnels, shock tunnels, arc-heated wind tunnels, and free flight ranges. These were categorized according to electron concentration, collision frequency, operating pressure, cost, geometric size, test time, and frequency of operation. Tests were formulated to evaluate reflection and attenuation effects, information rate, modulation parameters, antenna breakdown, and also complete systems. Author

N64-20281 California U., Livermore. Lawrence Radiation Lab.
GUIDING CENTER MOTION AND PLASMA BEHAVIOR IN THE BUMPY TORUS
G. Gibson, W. C. Jordan, E. J. Lauer, and C. H. Woods 28 May 1963 73 p refs
(Contract W-7405-ENG-48)
(UCRL-7246)

Drift surfaces of guiding centers in the Bumpy Torus static magnetic field were located and analyzed for various torus parameters by making use of the transverse adiabatic invariant $\mu = p_\perp^2/B$ and the longitudinal adiabatic invariant $J = \oint p_\parallel d\ell$. In addition, the drift equations (for which μ is an invariant) were solved numerically to investigate limitations on the application of the invariance of J. In general, J is an invariant for the drift equations under adiabatic conditions; however, some special guiding-center trajectories are presented for which the drift per longitudinal period is sufficiently large that the assumption of the invariance of J is not valid. Closed surfaces of constant $U = -\oint d\ell B$ were found. These are also surfaces of constant plasma pressure under static equilibrium conditions at low β for a hydromagnetic model. The stability of the equilibrium is discussed. Author

N64-20387 Chalmers U. of Tech., Göteborg (Sweden) Research Lab. of Electronics
DYNAMIC NON-LINEAR WAVE PROPAGATION IN IONIZED MEDIA. II: NON-LINEAR EXCITATION OF HYDROMAGNETIC WAVES AND HYBRID RESONANCES BY TWO INTERACTING HIGH POWER PRIMARY WAVES Research Report 39
K. H. B. Wilhelmsson Jul. 1963 38 p refs
(Contract AF 61(052)-451)
(US-36; AFCRL-63-786; AD-436878)

The purpose of the present report is to demonstrate that two interacting strong waves that propagate perpendicular to the direction of a static magnetic field in an ionized gas can generate, as nonlinear products, difference-frequency fields, which may be hydromagnetic waves or may exhibit so-called hybrid resonances. An infinitely extended homogeneous medium is considered, but does not include the effect of collisions. Author

N64-20408 Ford Instrument Co., Long Island City, N.Y. Nuclear Development Div.
LO-TEMP THERMIONIC PLASMA STUDY Yearly Report, Dec. 1963
M. Silverberg et al Washington, ONR, Dec. 1963 52 p refs
(Contract Nonr-3416(00))
(AD-429133)

An experimental program was conducted in which the low-temperature, impregnated-tungsten, cesium diode was extended from its original planar configuration to a cylindrical geometry. Various cylindrical converters were designed, fabricated, and operated in both steady-state and pulsating modes. A multiple collector device to evaluate and compare different collector materials in the same diode environment was designed and fabricated. Author

N64-20433 Stanford Research Inst., Menlo Park, Calif.
DISPERSION OF WAVES IN A COLD MAGNETO-PLASMA FROM HYDRODYNAMIC TO WHISTLER FREQUENCIES
Henry G. Booker and Rolf B. Dyce Aug. 1963 78 p refs

Dispersion of waves in the magnetosphere regarded as a cold plasma may be handled from whistler frequencies down to frequencies small compared with the ionic gyrofrequency by an approximation (Eq 22) similar to the Appleton–Hartree approximation (Eq 23) used at radiofrequencies. In both cases, the ratio of the ionic mass to the electronic mass is assumed infinite but is achieved for the hydromagnetic approximation by taking the electronic mass zero, whereas for the radio approximation this is achieved by taking the ionic mass infinite. This permits extension of the concept of quasi-longitudinal and quasi-transverse approximations to the entire frequency spectrum; propagation is predominantly quasi-transverse at frequencies small compared with the ionic gyrofrequency. The directional pulse patterns for radiation of a pulse from a source are calculated. The hydromagnetic approximation used facilitates detailed calculation of elliptical polarization and space-charge. Attenuation due to ionic collisions with neutral gas is calculated assuming the neutral gas is too massive to participate in the wave motion. Author

N64-20452 Space Sciences, Inc., Waltham, Mass.
EVALUATION OF EXISTING LITERATURE ON THE INTERACTION OF HIGH-DENSITY PLASMA WITH ELECTRIC, MAGNETIC AND FLUID-DYNAMIC FIELDS
W. E. Knabe Wright-Patterson AFB, Ohio, Aerospace Res. Labs., Feb. 1964 395 p refs
(Contract AF 33(657)-8761)
(ARL-64-34; AD-437769) OTS: $5.00

This report contains a review of recent publications on certain aspects of the interaction of plasmas, especially at high densities, with electric, magnetic and fluid-dynamic fields. The discussions refer in particular to theoretical and experimental studies of electric arcs. Discussed are the phenomenology and description of thermal arcs, and the phenomenology of the interaction of arcs and magnetic fields, including models, analyses, and interpretation of results. Principles of modern application (e.g., plasma acceleration) are also discussed. Author

N64-20455 Avco-Everett Research Lab., Everett, Mass.
WAVE GROWTH AND INSTABILITY IN PARTIALLY-IONIZED GASES
James E. Mc Cune (MIT) Apr. 1964 19 p refs
(Contract AF 04(694)-414)
(AMP-136; BSD-TDR-64-34; AD-437128)

The possibility of the amplification of random or induced pressure fluctuations in slightly ionized plasmas in the presence of a magnetic field was discussed previously by Velikhov and others. Basically, this amplification can occur through a coupling between the waves and the background plasma due to the induced fluctuations in those plasma parameters that depend on the thermodynamic properties of the gas. In general, amplification requires the presence of a steady-state current, and some of the most interesting cases occur in the presence of a large Hall effect. A simplified method is presented for studying a large class of wave disturbances in partially ionized gases. Emphasis is placed first of all upon the physical description of these waves and their amplification or damping characteristics, with a view to aiding the intuitive understanding of their nature. Depending on the frequency and the initial (steady) state of the plasma as well as the orientation of the wave vector, waves can be amplified at a rate significantly greater than that indicated by Velikhov. Author

N64-20480 Princeton U., N.J. Plasma Physics Lab.
A CALCULATION OF THE SPECTRAL DENSITY OF RADIATION SCATTERED BY A NON-EQUILIBRIUM PLASMA WHICH IS VALID FOR ALL WAVENUMBERS
Ronald L. Fante Oct. 1963 55 p refs
(Contract AT(30-1)-1238)
(MATT-217)

A formula was derived for the spectral density $S(k, \omega)$ of radiation scattered by a nonequilibrium plasma, valid for all wavenumbers k. The spectrum obtained is equal to the spectrum obtained by Rostoker, Rosenbluth, and Lamb plus a correction term important for large k. Author

N64-20523 Nagoya U. (Japan) Inst. of Plasma Physics
ENERGY LOSS OF AN ELECTRON BEAM IN A PLASMA
J. Uramoto (Ph.D. Thesis—Tokyo U., 1963) Feb. 1964 30 p refs
(IPPJ-22)

Energy loss of an initially uniform 1.1 kev electron beam injected into a plasma was studied with an electrostatic energy analyzer. The plasma is produced by the electron beam itself or by a gas discharge. The dependences of the energy loss on the pressure in the plasma region, on the intensity of the electron beam current, on the beam-plasma interaction length, and on the intensity of the gas discharge current were determined experimentally. The total energy loss per an electron of the beam amounts to 100 ev for a plasma density of 5×10^9 cm^{-3} and a beam current of 4 ma. The bunching process of the electron beam interacting with the plasma was analyzed on the basis of linear theory as well as of nonlinear theory. The energy loss can semiquantitatively be explained by taking account of the coherent interaction between electron beam and plasma. A theory of the latter process generalized to treat a series of bunched electrons is appended. Author

N64-20524 Nagoya U. (Japan) Inst. of Plasma Physics
THE KINETIC THEORY OF STABLE PLASMAS
Ta-You Wu (Polytechnic Inst. of Brooklyn) Mar. 1964 27 p refs A summary of 3 lectures
(IPPJ-24)

Based on three lectures, this summary is divided into the following sections: (1) a discussion of the kinetic theory of neutral gases—the Boltzmann theory; (2) a method of obtaining the master equation for irreversible processes; (3) a discussion of the Bogoliubov theory on neutral gases; (4) basic considerations of the kinetic theory of plasmas; and (5) formulation of a kinetic theory of plasmas from certain arbitrarily selected equations. A.W.

N64-20540 Pittsburgh U., Pa. Atomic and Plasma Physics Lab.
RECOMBINATION OF MOLECULAR POSITIVE IONS WITH ELECTRONS Technical Report No. 4
M. A. Biondi, T. R. Connor, C. S. Weller, and W. H. Kasner (Westinghouse Res. Labs.) Apr. 1964 25 p refs
(Contracts DA-ARO-(D)-31-124-G52; DASA-WEB-07.010) (APP-5; AROD-3187-4; AD-438042)

Results of studies of the recombination of electrons with molecular positive ions are presented. Theoretical arguments indicate that the dissociative process (in which a molecular ion captures an electron without change of energy, forming an unstable excited molecule that then dissociates) provides a highly efficient recombination mechanism. The nature of the process responsible for the large recombination rates observed in laboratory afterglow studies is investigated using combined microwave, optical spectrometric and interferometric, and mass spectrographic techniques. Dissociative recombination is shown to be the process operative in the laboratory studies, since it is found that (1) molecular positive ions must be present to observe a large recombination rate, (2) when diatomic ions are present, excited atoms are formed in the recombination process, and (3) these excited atoms have kinetic energy of dissociation substantially in excess of thermal energy. Author

N64-20562 General Motors Corp., Santa Barbara, Calif. Defense Research Labs.
ON THE THEORY OF THE RADAR-PLASMA ABSORPTION EFFECT Technical Report
H. M. Musal, Jr. Jul. 1963 191 p refs
(Contract DA-04-495-ORD-3567(Z); ARPA Order 347-63) (TR63-217A; AD-421889)

A brief review of the hypersonic aerodynamics, chemical physics, plasma physics, and electromagnetic wave scattering phenomena involved in the study of plasma effects on radar cross sections is given. The effect of the plasma sheath on the radar cross section of a hypersonic body can be considered separately from the effect of the plasma trail left behind the body. Several theoretical models of electromagnetic wave scattering from plasma-covered bodies are formulated and analyzed. The theoretical results of these analyses show both absorption and enhancement effects that could be caused by the plasma sheath. Theoretical predictions of plasma sheath effects calculated from the analyses of the theoretical models are compared with experimental results. The measured absorption and enhancement are both significantly greater than predicted by the theoretical results. Author

N64-20568 Radio Corp. of America, Moorestown, N.J. Missile and Surface Radar Div.
SPECULAR REFLECTION OF A PLANE WAVE BY A PLASMA-CLAD CONDUCTING BODY OF REVOLUTION. DOWNRANGE ANTI-MISSILE MEASUREMENT PROGRAM
A. D. Gottlieb and J. Steinberg Aug. 1963 24 p refs
(Contract DA 36-034-ORD-3144Z; ARPA Order 51) (RCA-DTM-63-05; AD-416212)

An expression was developed to find the strength, at a distance (R), of an electromagnetic field reflected specularly from a plasma-clad conducting body of revolution. This work was performed as a part of the overall DAMP task of increased understanding of the performance of ballistic missiles during their terminal phase of flight and enhanced comprehension of the metric techniques useful in evaluating missile performance. The ultimate objective of this report is defining far-field effects from the interaction of electromagnetic waves and their propagation-medium discontinuities due to plasma and wake. Author

N64-20587* Maryland U., College Park Center for Atmospheric and Space Physics
A RELATIONSHIP FOR PLASMA SHEATHS ABOUT LANGMUIR PROBES Technical Report No. 350
Richard T. Bettinger and E. Harris Walker Jan. 1964 14 p refs
(NASA Grant NsG-58-60) (NASA CR-53971) OTS: $1.60 ph

An analytical relation for the sheath about a spherical Langmuir probe was empirically derived from calculated data that reproduces this data within a mean error of better than 10%. A semiquantitative analysis verifies the functional dependence of this relation, and a similar analysis develops the corresponding relationship for cylindrical geometry. In the absence of sophisticated calculations in the cylindrical case a detailed evaluation of coefficients is not possible. The relations herein derived, even in their present crude form, greatly help analyze experimental Langmuir probe results, particularly those involving spherical geometry. Author

N64-20612 Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center
LONG LIFE CLOSED LOOP MHD RESEARCH AND DEVELOPMENT UNIT Interim Scientific Report No. 7, Sep. 15, 1963-Dec. 15, 1963
R. L. Hundstad 31 Dec. 1963 32 p ref
(Contract AF 33(657)-8311) (AD-428194)

Features of the control panel layout and function are discussed, and additional calculations predicting loop performance are presented. A metallographic examination of an expendable portion of the tantalum structure was made after a full-scale test. The material shows no evidence of deterioration that can be attributed entirely to the dissolution of impurities from the working fluid. The design of the closed loop modified with ceramic-lined end returns is presented as a replacement for the existing structure when the tantalum ultimately fails. Author

N64-20633 Weapons Research Establishment (Australia) Australian Defence Scientific Service
THE INFLUENCE OF PROBE POTENTIAL ON THE ELECTRON ENERGY DISTRIBUTION IN A PLASMA
E. H. Hirsch Mar. 1964 14 p refs
(WRE-TN-CPD-83)

The electron energy distribution in a hot-cathode low-pressure discharge is measured by a probe and by means of an electrostatic energy analyzer. Probe data indicate a non-Maxwellian primary group and two Maxwellian electron groups of lower energy, but the analyzer spectra show no Maxwellian groups. It is found that the probe potential can modify the number and energy distribution of electrons incident on the probe, and this effect is suggested as an explanation of the Langmuir paradox. Author

N64-20634 Los Alamos Scientific Lab., N. Mex.
NUMERICAL STUDIES OF THE THETA PINCH
T. A. Oliphant, Jr. 4 Dec. 1963 87 p refs
(Contract W-7405-ENG-36) (LAMS-2944) OTS: $2.00

Described is a computer program written for the IBM-7094 for computing the plasma behavior in the theta pinch. The plasma is treated as a hydromagnetic fluid interacting with the external circuit by means of the magnetic field that builds up along the axis of the containing cylinder. No charge separation is assumed so that the electronic and ionic components

move together as a single fluid. Separate electronic and ionic temperatures are considered so that two energy conservation equations are obtained. Each energy equation includes thermal conductivity so that in each case a diffusion equation results. The electrical conductivity is assumed to be finite so that a diffusion equation is attained for the magnetic field. Including the momentum conservation equation, therefore, a wave equation and three diffusion equations result. The mass conservation equation is used to transform the above four equations to Lagrangian coordinates. The numerical schemes consist of very straightforward difference analogs to the resulting four equations in Lagrangian coordinates. Problems with 10 mesh intervals, that can be run in about 3 minutes on the IBM-7094 compare reasonably well with problems of a more refined mesh. Author

N64-20646* Thompson Ramo Wooldridge, Inc., Cleveland, Ohio TAPCO Div.
RESEARCH ON THE VORTEX MHD POWER GENERATOR Second Quarterly Progress Report
W. C. Davis, E. L. Krasnoff, and W. F. Wade Oct. 1962 17 p refs
(NASA Contract NAS3-2526)
(NASA CR-56081; ER-5084) OTS: $1.60 ph

Fabrication of the experimental model of the vortex MHD generator was completed; this generator is intended to be the primary hardware item in the research program and to serve in the correlation and refinement of existing methods for predicting generator performance. A review of possible techniques to measure plasma enthalpy was conducted. For purposes of determining local heat-transfer coefficients within the vortex generator and also the generator conversion efficiency, a gas dilution type of calorimeter was indicated. A calorimeter was therefore constructed, and its initial function will be to determine the enthalpy of the driving jets under conditions simulating those within the generator. Fabrication and installation of the vortex chamber were completed. This is geometrically similar to the vortex generator and is expected to be the major facility that will be employed for a detailed study of the velocity field in a compressible vortex. The preliminary application of a pseudo laminar type of turbulent boundary layer analysis to the flow in a vortex containing a porous center body was completed. Author

N64-20651* Maryland U., College Park Inst. for Fluid Dynamics and Applied Mathematics
COLLISION DAMPING OF PLASMA OSCILLATIONS — I
David Montgomery and David Gorman (Washington U., St. Louis) Repr. from Phys. Rev., v. 131, no. 1, 1 Jul. 1963 p 7–12 refs Previously Published as N63-16446 14-24)
(NASA Grant NsG-220-62; NSF-G-24834)

Collision damping of long-wavelength electrostatic oscillations in a high-temperature plasma is studied with the use of Guernsey's kinetic equation. A closed expression for $\gamma c(k)$, the collision damping decrement, is derived, and is exact to first order in the plasma parameter, $k_D{}^3/n$. Author

N64-20677 General Electric Co., Philadelphia, Pa. Space Sciences Lab.
ARC HEATER DEVELOPMENT FOR ENTRY SIMULATION
T. K. Pugmire, H. E. Weber, and C. H. Marston Oct. 1963 36 p refs
(Contract AF 04(694)-222)
(R63SD49; AD-422427)

Spectrographic and calorimetric techniques were developed to obtain temperature profiles and enthalpy levels of the airflow in the arc. Probe techniques were developed to measure column voltage gradients and velocity profiles. Arc air radiation was also examined both analytically and experimentally. A high pressure arc unit was developed that could be used to determine arc performance characteristics between 10 and 100 atmospheres pressure. This unit could also be used for experimental verification of theoretical radiation heat-transfer predictions for all conditions of planetary entry. In support of the experimental programs, the equations of motion and the energy equation were integrated for velocity and temperature profiles. With the most recent analytical calculations of electrical and thermal conductivities and radiant heat emission, the solutions of the energy equation have yielded arc temperature profiles, voltages, currents, and flow rates that begin to correlate well with the same quantities measured experimentally. The increased predicted radiative heat transfer (utilizing the most recent calculations of Breene et al) together with molecular energy transport theory yields good correlations without resort to turbulent diffusivity theory. Author

25 PHYSICS, SOLID-STATE

Includes semiconductor theory; and masers. *For related information see*: 09 Electronics; 23 Physics, General; and 24 Physics, Plasma.

N64-20032 Radio Corp. of America, Camden, N. J. Defense Electronic Products
CERENKOV MICROWAVE GENERATOR First Interim Technical Report, Jun. 1963-Dec. 1963
J. Andersen et al Griffiss AFB, N.Y., RADC, Apr. 1964 82 p refs
(Contract AF 30(602)-3061)
(RADC-TDR-64-103; AD-438053)

Cerenkov cw radiation was produced by the interaction of a modulated flat-ribbon electron beam with a scalar dielectric reactor. Measurements of the radiation were made at the fundamental frequency (6.33 Gc) and at the second and third harmonics. The dependence of the generated power on accelerating voltage, bunch power, and beam current was examined. The dielectric reactor used consists of two hemicones having a dielectric coefficient of about 6 at 6.33 Gc. For typical operating conditions of beam current = 0.3 ma, accelerating voltage = 70 kv and bunch power = 1 w, approximately 7.5×10^{-6} w of Cerenkov radiation was obtained at 6.33 Gc. Based upon the calculated amplitude of the current at 6.33 Gc, a value of 193 ohms is obtained for the interaction resistance. Because of the relatively poor collector efficiency, it is estimated that the Cerenkov power may actually have been as much as 100 times greater than the measured level. Also given are the results of analytical investigations of: (1) design considerations for a charge dissipative overlay; (2) the effects of finite beam width on power coupled into a Cerenkov reactor; and (3) thermal limitations of high power Cerenkov generators. Author

N64-20087 California Inst. of Tech., Pasadena Quantum Electronics Labs.
AN ANALYSIS OF MULTIREFLECTOR OPTICAL RESONATORS Scientific Report No. 4
Peter O. Clark 27 Feb. 1964 161p refs
(Contract AF 19(604)-8052)
(AFCRL-64-161; AD-437795)

Geometrical optics and self-consistent field techniques are used to determine the properties of multireflector optical resonators in which the field distributions are multiply-reflected and travel in clockwise and counter-clockwise directions in the cavity. Two types of resonators are considered: a symmetric N-mirror resonator whose axis is a regular N-sided polygon, and a nonsymmetric four-mirror resonator whose axis is a parallelogram. The geometrical optics approach leads to sets of coupled nonlinear difference equations that describe the paths of optical rays in the resonators. Approximate solutions to the equations are obtained and a calculation of the first correction term is carried out in the case of the symmetric cavity. Integral equations are obtained that determine the mode distributions in the symmetric N-mirror and nonsymmetric four-mirror cavities. Resonance conditions and detailed descriptions of the field distributions are obtained for both the symmetric and nonsymmetric resonators. P.V.E.

N64-20105 Shell Development Co., Houston, Tex.
A NOTE ON THE COMPUTATION OF RALEIGH WAVE DISPERSION CURVES FOR LAYERED ELASTIC MEDIA Scientific Report No. 1
J. H. Rosenbaum 7 Jan. 1964 13 p refs
(Contract AF 19(628)-2785; ARPA Order 292)
(AFCRL-64-231; AD-437669)

In the computation of Rayleigh wave dispersion curves for layered elastic media, difficulties arise that take the form of a loss of significant figures and that can be ascribed to the fact that the motion in one section of the medium is weakly or only partly coupled to the motion in another section. These difficulties can be effectively removed if account is taken of such decoupling effects. Author

N64-20126 Radio Corp. of America, Princeton, N.J. RCA Labs.
SOLID STATE LASER EXPLORATIONS Interim Engineering Report No. 2, Jan. 16, 1964-Apr. 15, 1964
J. Collard, Z. J. Kiss, R. J. Pressley, F. Sterzer, T. Walsh et al
Wright-Patterson AFB, Ohio, ASD, 1 May 1964 60 p refs
(Contract AF 33(615)-1096)
(AD-438170)

Attempts to operate a color-center pumped CaF_2:ErOF crystal as a laser were unsuccessful. Spectroscopic studies and improvements were continued in crystal growth techniques for the alkaline earth halide and halofluoride systems. The chemical reduction technique for obtaining divalent dysprosium in CaF_2 was developed to the point where several high-quality laser rods were produced. The effects of temperature changes on the optical cavity modes were computed. $CaF_2:Dy^{2+}$ lasers with high-reflectivity spherically polished ends gave a nonspiking beam exhibiting little amplitude modulation at high output. Absorption from excited $^5I_7$ and $^5I_6$ states in $CaF_2:Dy^{2+}$ was observed directly. A double-elliptic reflector laser pumping system with two pump lamps was built, and achieved higher excitation levels than previously. Measurements of beam power as a function of output coupling were made. Using negative feedback via a magnetic field, the amplitude modulation observed on the beam from a spherically ended laser was reduced by a factor of two. Results of Q-switching experiments are reported. Techniques were developed for the annealing, encapsulation, and handling of CuCl and hexamine electro-optic crystals to avoid the introduction of strains.
R.T.K.

N64-20146 Pennsylvania U., Philadelphia
FERROMAGNETIC CURIE TEMPERATURE IN CUBIC LATTICES WITH NEXT NEAREST NEIGHBOR INTERACTION Technical Report No. 13
R. A. Tahir-Kheli (Pakistan AEC) and H. S. Jarrett (E. I. du Pont de Nemours) Mar. 1964 13 p refs
(Contract Nonr-551(36))
(AD-435886)

Magnetic systems were successfully studied through methods involving the Green function. In general, a simple "random phase" decoupling approximation (RPA) leads to acceptable results for the Curie temperatures for both ferromagnetic and antiferromagnetic systems. The extension of the Green function methods to the study of situations including the second neighbor exchange in addition to the nearest neighbor exchange is discussed. The resulting sums for face-centered and body-centered cubic lattices of both exchanges are given in tabular form. Curie temperatures were determined by investigating the limit when, in the absence of the applied field, the statistical average (being proportional to the system magnetization) approaches zero. A.W.

N64-20155 Rutgers U., New Brunswick, N.J.
RESEARCH IN SOLID STATE THEORY Progress Report
Apr. 1964 10 p refs
(Contract Nonr-404(13); NSF Grant G-24277)
(AD-437194)

Research completed in solid-state theory is reviewed. Additional calculations on the effects of paramagnetic impurities in superconductors were made. The density of states in energy was computed. The Landau expression for the paramagnetic susceptibility of a Fermi liquid was derived from first principles within the framework of the many-body perturbation theory. There was no abrupt change in the thermal conductivity in going from the normal to the superconducting state. Research in the following areas is also discussed: (1) the many-body effects on the magnetic properties of metals; (2) the magnetic field modulation of the Josephson a.c. supercurrent; (3) anisotropic thermal conduction in type II superconductors; (4) thermal conductivity in dilute alloys; (5) the transition temperature of helium^3; and (6) infrared absorption in impure superconductors. I.v.L.

N64-20156 General Electric Co., Owensboro, Ky. Tube Dept.
INTERIM TECHNICAL REPORT ON THE RESEARCH, DEVELOPMENT, AND FABRICATION OF TUNNEL EMISSION CATHODES Final Report, Jul.-Nov. 1963
J. W. Hall, II [1963] 71 p refs
(Contract DA-49-186-ORD-1053)
(AD-437273)

Metal–insulator–metal (M-I-M) sandwiches have been studied as an electron source for possible use as a cathode in electron tubes. The M-I-M sandwich, which had an area of 0.01 cm^2, consisted of an aluminum base layer, a thin layer of Al_2O_3, and a thin metal accelerator layer. Twelve metals were investigated as accelerator layers for the Al-Al_2O_3 system with the most promising results obtained with gold. Experimental results are reported, which show that sandwich capacitance, film resistance, and the film current (current through the insulator) increased as the temperature was increased from 26° C to 150° C. Also, the effect of temperature and the substrate surface on film structure were studied. The transmission coefficient (emission current–film current) was found to be highly dependent on the accelerator thickness and practically independent of the oxide thickness. The sandwiches were tested under both pulsed and d.c. conditions. Electron transmission and diffraction microscopy were used extensively to study the effects of temperature and the substrate on film structure and the change in film structure that occurred during operation. Present indications are that the M-I-M sandwich

should be suitable as an electron source especially at low temperatures. Author

N64-20173 Sperry Gyroscope Co., Great Neck, N.Y. Electro-Optics Group
ANALYSIS OF OPTICAL RESONATORS INVOLVING FOCUSING ELEMENTS Scientific Report No. 2
Stuart A. Collins, Jr. and Edward W. Cheatham Dec. 1963 27 p refs Presented at Semiann. Meeting of the Opt. Soc. of Am., Chicago, 23-25 Oct. 1963 Submitted for Publication
(Contract AF 19(628)-2924)
(AB-1108-0021; AFCRL-63-933; AD-438428)

The electromagnetic fields in optical resonators involving focusing elements are considered. The work is restricted to cases in which the electromagnetic fields are small at the edges of any optical elements so that there is no significant aperturing. The paper presents the analytical solution for the fields across two reference surfaces (often the end mirrors) within the resonator, and describes graphically the fields inside and outside the resonator. The analytical solution uses Huygens' principle, but maintains generality in that the expressions relating the geometry of the particular optical resonator are left in terms of constants, which can be simply evaluated for the particular resonator. The expressions for the fields (over the reference surfaces), resonant frequencies, and stability conditions are given. The graphical description of the fields inside and outside the resonator is in terms of two experimentally observable variables: the radius of curvature of phase fronts and the spot size. Author

N64-20277 California U., Berkeley. Lawrence Radiation Lab.
INFLUENCE OF QUENCHING CONDITIONS ON VACANCY LOOPS IN ALUMINUM
Gobinda Das (M.S. Thesis) Jan. 1964 55 p refs
(Contract W-7405-ENG-48)
(UCRL-11188)

Great differences in the substructure of quenched and aged 99.999%-purity aluminum were caused by varying the thickness of specimens at the time of quenching, though all other important variables like quenching temperature, aging temperature, and time and purity were kept constant. The thickness of the specimens was varied within the range 25 to 400μ. All specimens were quenched from 543° C into water at 40° C and aged at 40° C for 5 minutes. The size of dislocation loops resulting from clustering of excess vacancies progressively increased, and their density decreased with increasing thickness of the specimens. In the thinner specimens the loops were primarily faulted with Burger's vector a/3[111], whereas in the thicker specimens perfect a/2[110] loops predominated. For the 400μ specimens, nearly all loops were perfect and diamond shaped with all four sides lying on {111} planes. The habit plane of the diamond shaped loops was approximately {023}. The concentration of vacancies necessary to account for the size and density of loops was approximately independent of specimen thickness. Author

N64-20291 Genoa U. (Italy) Inst. of Experimental Physics
THERMOCONDUCTIVITY OF SOLID ARGON Quarterly Technical Status Report No. 2, 1 Jul.-30 Sep. 1963
Giovanni Boato 30 Oct. 1963 3 p
(Contract DA-91-591-EUC-2861)
(AD-437659)

Thermal conductivity measurements of solid argon have been continued; data are being analyzed in order to correlate the thermoconductivity values with the amount of imperfections in the crystal. Two experiments performed with very pure argon were not successful because of thermal resistance at the upper contact and difficulties in bringing the bath temperatures below 3.5° K. J.E.T.

N64-20381 Technical Research Group, Inc., Melville, N.Y.
RESEARCH ON PROPERTIES OF LASER DEVICES Quarterly Technical Summary Report No. 7, 1 Dec. 1963-29 Feb. 1964
R. Kaplan, ed. [1964] 126 p
(Contract AF 49(638)-673; ARPA Order 256-62; Proj. Defender)
(TRG-134-QTR-7; AD-437576)

Discussed is the research performed on laser devices; the effort was devoted to the four major tasks of gas lasers, solid-state lasers, output control, and analytical studies, as follows: A survey of gaseous systems for collision-relaxed discharge lasers was performed, and various techniques for increasing the ratio of electron-to-gas kinetic temperature were considered. The experimental implementation of a photodissociation laser was continued and the effect of turbulence and convection within the optical resonator was studied. The development of a nuclear-pumped solid-state laser was continued. The application of the Lummer–Gehrcke plate as a mode selector was studied; an experimental comparison with the distant-mirror mode selector was performed. Measurements of the damage to optical materials under laser irradiation were made. The analysis of coherent detection of diffusely reflected light was extended. In addition, immersion effect in dielectric resonators was analyzed for various geometries. Author

N64-20393 United Aircraft Corp., East Hartford, Conn. Research Labs.
ULTRASONIC LIGHT SCANNING AND ACTIVE OPTICAL IMAGING SYSTEM Quarterly Status Report No. 2, 19 Sep.-19 Dec. 1963
H. G. Aas, R. K. Erf, I. R. Abel, and R. Walker 17 Jan. 1964 27 p refs
(Contract NOw-63-0657-d)
(C930080-6; AD-428018)

Presented is a description of the progress in research and development of an ultrasonic light scanning and active optical imaging system. Efforts on the ultrasonic light scanning portion of the work were concentrated on the analytical evaluation and experimental development of a liquid deflection cell. Peak-to-peak deflections of 1.0° and 0.35° were realized with the transducers mounted externally and internally, respectively. With the external transducer-configuration, bonding problems set the upper deflection limit; an impedance mismatch between the power amplifier and transducers limited the deflection with the latter configuration. Studies were carried out with the crystal quartz cell, and deflections of approximately 1.2° were obtained. Finally, experimental studies of the bending mode, rather than the compressional mode, were initiated by manually deflecting a cantilevered lucite beam. Analytical and experimental results of the active optical imaging system are presented. With a diffraction-limited 5-mm laser beam as the light source, a resolution corresponding to approximately 1.2 ft at 1 nmi is possible. Author

N64-20394 Sylvania Electric Products, Inc., Mountain View, Calif. Microwave Device Div.
RESEARCH ON TECHNIQUES FOR LIGHT MODULATION DETECTION Interim Engineering Report No. 6, 1 Sep. 1963-1 Dec. 1963

E. O. Ammann, R. Targ, S. E. Harris, and J. B. Gaenzle [1963] 133 p refs
(Contract AF 33(657)-8995)
(AD-428980)

An applied research program to establish techniques for light modulation detection is described. Research on heterodyne demodulation and direct demodulation of FM light is discussed. Results are given in the following areas: (1) experimental measurements on the optical ratio detector; (2) theoretical work resulting in two techniques for realizing any desired optical frequency characteristic, paving the way for a second generation of birefringent devices designed specifically to meet some system specification; (3) demonstration of heterodyne and homodyne techniques for the demodulation of AM and FM microwave-modulated light; and (4) an AFC local oscillator using single-sideband suppressed-carrier modulation to control its frequency to use in an optical heterodyne receiver. Author

N64-20397 Monsanto Research Corp., Dayton, Ohio
STUDIES IN SOLID STATE MASS SPECTROMETRY Technical Documentary Report, 1 Jul. 1962-1 Jul. 1963
F. N. Hodgson and J. E. Katon Wright-Patterson AFB, Ohio, Res. and Technol. Div., Dec. 1963 29 p refs
(Contract AF 33(616)-8465)
(RTD-TDR-63-4145; AD-428995)

Molecular carbon species present in the vacuum spark of the mass spectrograph were studied for various forms of carbon. Included in the study were graphite, diamond, amorphous carbon, and carbides. Each form shows a unique carbon association pattern with groups of carbon atoms appearing only to C_8 or C_9 for amorphous carbon as compared to C_{28} for graphite and to C_{24} in earlier data on fused aromatic structures. Special techniques were developed to run volatile samples, to ionize gases in the spark source, and to produce a mass reference plate based on spark spectra containing combinations of carbon and hydrogen. A method for quantitative impurities analysis is outlined and is illustrated by a determination of oxygen in beryllium. The present state of performance of the gas inlet and Knudsen cell sources is discussed. Author

N64-20398 Naval Ordnance Test Station, China Lake, Calif. Aviation Ordnance Dept.
A MEANS OF AIMING A LASER BEAM
L. W. Nichols Jan. 1964 5 p
(NAVWEPS-8491; NOTS-TP-3446; AD-429341)

The retrodirective reflecting properties of a corner reflector can be used to aim a laser beam. When portions of a corner reflector are placed in front of a laser and its aiming telescope, then an image of the laser beam is superimposed on the telescope image to show the exact target area being illuminated by the beam. Author

N64-20400 Little (Arthur D.) Inc., Cambridge, Mass.
SUPERCONDUCTIVE EFFECTS IN THIN FILMS Interim Engineering Report No. 7, 15 Jul.-15 Oct. 1963
S. Shapiro and E. J. Mc Niff, Jr. 15 Nov. 1963 25 p refs
(Contract AF 33(657)-7915)
(C-64380; AD-428788)

The mixing of two microwave signals has been accomplished unambiguously in experiments employing the nonlinear I-V characteristic of superconducting tunneling samples. Although a doubly resonant microwave cavity was used in the earliest experiments, difficulties with cavity Q-values led to the adoption of a scheme in which the sample was situated roughly a quarter guide wavelength from the end of a shorted waveguide. Several unexplained effects have been observed in the I-V curves of a number of tunneling junctions. One effect involves excess current at lower voltage over that expected from single-particle tunneling in most samples with appreciable zero-voltage Josephson current. The other effects, all occurring in the presence of microwave power with junctions showing Josephson current, involve the tilting or gradual restoration of resistance at the origin in the I-V curve, the appearance of zero-slope resistance regions for apparently shorted samples, and, for Pb-Al junctions, the appearance and then continuous and gradual separation in voltage of prominent steps in the I-V characteristic. Author

N64-20412 Massachusetts Inst. of Tech., Cambridge
SOLID-STATE AND MOLECULAR THEORY GROUP Quarterly Progress Report No. 52
J. C. Slater et al 15 Apr. 1964 113 p refs
(Contracts Nonr-1841(34); AF 19(628)-356; Grant NSF-G-24908)
(AD-437231)

CONTENTS:

1. MAGNETIC BREAK-DOWN IN A SIMPLE MODEL W. G. Chambers p 3–32 refs (See N64-20413 13-25)
2. SYMMETRY PROPERTIES IN THE SPACE GROUP O_h^4(Pn3m) J. P. Dahl p 33–46 refs (See N64-20414 13-25)
3. EXPANSION THEOREMS FOR SOLID SPHERICAL HARMONICS II J. P. Dahl p 47–50 refs (See N64-20415 13-20)
4. COVALENCY IN CRYSTAL FIELD THEORY: $KNiF_3$ R. E. Watson and A. J. Freeman p 51–108 refs (See N64-20416 13-25)

N64-20413 Massachusetts Inst. of Tech., Cambridge
MAGNETIC BREAK-DOWN IN A SIMPLE MODEL
W. G. Chambers *In its* Solid State and Mol. Theory Group 15 Apr. 1964 p 3–32 refs (See N64-20412 13-25)

A model is set up that consists of an electron in a periodic potential that depends on one dimension only. The resulting Schrödinger equation is separable. This equation is used to derive a criterion for the magnetic breakdown first suggested by Blount (1962). The magnetic translation operators, first introduced by Brown (1964), that correspond to the ordinary translation operators when there is no magnetic yield are considered. By means of these operators, it is possible to derive a crystal momentum and to derive a theorem for the expectation velocity of an electron. This theorem is used to obtain the band structure of the simple model when the breakdown is small. Also considered is the transformation of the Schrödinger equation, by means of which it is possible to derive the band structure from another point-of-view, and to calculate its form quantitatively (again when the breakdown is small). R.T.K.

N64-20414 Massachusetts Inst. of Tech., Cambridge
SYMMETRY PROPERTIES IN THE SPACE GROUP O_h^4(Pn3m)
J. P. Dahl *In its* Solid State and Mol. Theory Group 15 Apr. 1964 p 33–46 refs (See N64-20412 13-25)

The irreducible representations for the space group O_h^4 have been worked out, using the method of approach applied by Slater in a study of several space groups. The irreducible representations for O_h^4 have previously been obtained by Zhilich, and they are also contained in Kovalev's book on space groups. These publications are in Russian and use the Seitz convention, and it was therefore felt worthwhile to present an independent investigation. At the same time, the opportunity is taken to show that in certain cases, including the present, it

is possible to make a smooth transition from Kovalev's tables to tables derived using Slater's method. Author

N64-20416 Massachusetts Inst. of Tech., Cambridge
COVALENCY IN CRYSTAL FIELD THEORY: $KNiF_3$
R. E. Watson and A. J. Freeman *In its* Solid State and Mol. Theory Group 15 Apr. 1964 p 51–108 refs (See N64-20412 13-25)

The theory of covalency in crystal-field phenomena is examined, using the cluster model for $KNiF_3$ as an example. The covalent mixing of those bonding electrons that have no antibonding partners was found to be the appropriate manifestation of covalency. The molecular orbital approach to covalent mixing and the one-electron Hamiltonian appropriate to the system are discussed. Also discussed is the covalent mixing appropriate to transferred hyperfine and crystal-field splitting effects, respectively. The role of the unpaired bonding electrons becomes apparent. Throughout, the traditional antibonding model is examined in parallel. The evaluation of the covalent mixing, the role of self-energy terms, and the various matrix elements appearing in the calculations are discussed. R.T.K.

N64-20447 Texas Instruments, Inc., Dallas Semiconductor-Components Div.
PRODUCTION ENGINEERING MEASURES TO INCREASE TRANSISTOR RELIABILITY Fifth Quarterly Progress Report, 1 Jul. 1963-30 Sep. 1963
Milt Le Baron, Elmer Wolff, Milton K. Mack, and James H. Overman [1963] 27 p
(Contract DA-36-039-SC-86730)
(Rept. 03-64-09; AD-436711)

The purpose of this project was to evaluate and adopt proposed process improvements toward achieving a maximum failure rate of 0.01% per 1,000 hr at a 90% confidence level for the Silicon Triple Diffused Transistor Type 2N656. The results of the tests, considerably more severe than those normally required for the mesa 2N656, indicated that the planar 2N656 is a very rugged and reliable device. It is anticipated that the 1,100 devices now being placed on stress tests will confirm that the 0.01%/1,000 hr failure rate objective was more than met. Author

N64-20448 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
MICROWAVE RESONANCE PROPERTIES OF SINGLE-CRYSTAL FERRITES WITH UNIAXIAL ANISOTROPY
Maurice Weiner 17 Mar. 1964 37 p refs
(USAELRDL-TR-2384; AD-437668)

The influence of uniaxial anisotropy on several important microwave phenomena in ferrites is presented. Specifically, it is shown that the major change in the linear theory when the d.c. field, H, is along the symmetrical axis, is equivalent to a shift in the static field. When H lies in an easy plane, an intrinsic ellipticity is introduced into the precessional motion, which is reminiscent of shape anisotropy. Calculations of the critical fields due to spin-wave instability show a nontrivial result for the second-order effect when H is directed along the symmetrical axis. In addition, the more complicated results that occur when H lies in an easy plane are described. Author

N64-20459 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
ON THE PROBABILITY OF THE PHONONLESS TRANSITION IN THE IMPURITY CENTERS OF CRYSTALS
E. D. Trifonov 8 Apr. 1964 10 p refs Transl. into ENGLISH from Doklady Akad. Nauk SSSR (Moscow), v. 147, no. 4, 1962 p 826–828
(RSIC-156; AD-437958)

The probability value of the phononless transition in the impurity in the center of a crystal was derived and is represented by $P(\omega_0) = e^{-\mu_1/\omega_{cp}}$, where $P(\omega_0)$ is the probability value, μ_1 is the first moment that determines the center of weight in the spectral distribution, or half of the stokes losses, and ω_{cp} is a certain average frequency located in the interval $(0, \omega_{max})$. Thus, the probability of the phononless transition will be the greater, the lower to stokes losses are and the greater the value of the average oscillating quantum is. By comparing $P(\omega_0)$ with the second and higher momentums of the spectral curve, it is possible to find the relation between the temperature dependence of $P(\omega_0)$ and the band-shaped temperature change. I.v.L.

N64-20525 Nihon U., Tokyo (Japan)
COLLECTIVE OSCILLATIONS OF ELECTRON-HOLE SYSTEM IN GRAPHITE
Yoshi H. Ichikawa and Kenji Kobayashi (Tokyo U.) [1963] 23 p refs
(NUP-64-3)

Collective oscillations of the conduction electrons and holes of π-bands in graphite are investigated on the basis of the quantum mechanical Boltymann–Vlasov equation. Expressions of the eigen frequencies of the plasma oscillation and the zero soundwave are calculated numerically by considering the electronic band structure in graphite in depth. Measurements of the optical properties of graphite in the infrared region will provide experimental evidence of the plasma oscillation and the zero soundwave. Author

N64-20574 Union Carbide Research Inst., Tarrytown, N.Y.
STATIC ATOMIC DISPLACEMENTS RESULTING FROM VACANCIES IN DEFECT STRUCTURES $TiN_x \square_{1-x}$
C. R. Houska Apr. 1964 16 p refs
(Contract DA-30-069-ORD-2787)
(C-22; AD-437205)

Both static atomic displacements (resulting from vacancies) and vibration amplitudes were measured in specimens having the compositions $TiN_{0.59}$, $TiN_{0.78}$, and $TiN_{0.95}$. The static displacements for titanium (and nitrogen) in the first two specimens were found to be about 5.5% of the first neighbor distance and were comparable to the dynamic displacements at 250° C. Static displacements were not observed for $TiN_{0.95}$. The specimen of intermediate nitrogen concentrations, $TiN_{0.78}$, had smaller dynamic displacements and thermal expansions than the other two specimens, indicating the existence of a minimum in these thermal properties. Author

N64-20585* Monsanto Research Corp., Dayton, Ohio
DEVELOPMENT OF IMPROVED SINGLE CRYSTAL GALLIUM PHOSPHIDE SOLAR CELLS Quarterly Report No. 3, Dec. 12, 1963-Apr. 12, 1964
W. O. Groves and A. S. Epstein [1964] 52 p refs
(NASA Contract NAS3-2776)
(NASA CR-53986) OTS: $5.60 ph

The current program status includes: (1) Single crystal gallium phosphide was prepared by epitaxial deposition on single crystal gallium arsenide using hydrogen chloride in an open tube vapor transport process with phosphorus and gallium sources. The effect of phosphorus pressure during growth of the gallium phosphide crystals on solar cell properties was investigated. (2) The vapor transport and epitaxial deposition of

gallium phosphide by water vapor were investigated. (3) It was possible to obtain solar cells having only the desired primary spectral response peak of 0.45μ by correlating the gallium phosphide growth rate variables with solar cell electrical and optical properties. These cells have produced the best electrical properties found thus far at room temperature in sunlight. (4) The open-circuit voltage-temperature relationships of the fabricated gallium phosphide solar cells were examined. A temperature coefficient of open circuit voltage of about 3 mv/° was obtained that agrees well with calculations made from a simple solar cell model, assuming that only the energy gap of gallium phosphide is temperature dependent. I.v.L.

N64-20658 Joint Publications Research Service, Washington, D.C.
ACTIVE MATERIALS WHICH CAN PRODUCE OPTICAL MASER ACTION
Sung-hao Liu *In its* Transl. on Communist China's Sci. and Technol., no. 82 12 May 1964 p 23–56 refs Transl. into ENGLISH from K'o-hsueh T'ung-pao (Peiping), no. 2, 17 Feb. 1964 p 127–139 (See N64-20657 13-01) OTS: $2.25

A detailed discussion is presented on impurities-excited fluorescent crystals and semiconductors. The discussion is divided as follows: (1) gas—special features of gas active materials, the structure that produces optical maser action in gas active materials, He-Ne gaseous optical maser; (2) impurity-excited fluorescent crystals—over-compensated metal ions excited fluorescent crystals, rare earth ions excited fluorescent crystals, actinide series ions excited fluorescent crystals; (3) impurities-excited fluorescent glass; (4) organic fluorescent materials—organic compounds of the aromatic family, rare earth chelated compounds, light sensitive organic compounds, organic materials that produce Raman coherent emission; (5) semiconductor active materials—special features of semiconductor active-materials, some possible different plans to accomplish stimulated emission by using semiconductors, GaAs p-n junction; and (6) the development trend of active materials. P.V.E.

N64-20688* General Electric Co., Philadelphia, Pa. Space Sciences Lab.
THE SYNTHESIS OF BORON CARBIDE FILAMENTS First Quarterly Report — Rev.
A. Gatti, R. Cree, and E. Feingold 31 Jan. 1964 34 p refs
(NASA Contract NASw-670)
(NASA CR-56101) OTS: $3.60 ph

A study was started having as its goal the synthesis of boron carbide whiskers, their characterization in terms of chemical and physical properties, and the utilization of such whiskers in composites. Boron carbide whiskers were grown successfully both by evaporation from pure B_4C vapor and by a chemical method based on the flow of appropriate gases over a heated substrate. Thus far, the best whiskers were grown by the pure vapor method. The experimental conditions required to grow B_4C whiskers, along with a description of the experimental equipment used, are presented. Included in this progress report is a short history of whisker growth and their properties in general. The expected advantages that could be realized if B_4C whiskers can be grown and utilized effectively in composites are discussed. Author

N64-20694* Rensselaer Polytechnic Inst., Troy, N.Y.
ULTRASONIC ATTENUATION IN SUPERCONDUCTING LEAD
R. E. Love and R. W. Shaw Repr. from Rev. Mod. Phys., v. 36, no. 1, Jan. 1964 p 260–263 refs
(NASA Grant NsG-100-60)

The ultrasonic attenuation of lead was measured in various crystallographic directions over the temperature range 2° to 20° K, both in magnetic field and zero field, in an attempt to determine the superconducting energy gap. A standard ultrasonic pulse technique was used to measure the attenuation. The apparatus consisted basically of a modified Sperry attenuation comparator. Additional amplifiers, attenuator, and detection circuits were used to allow the amplitude of a particular echo to be continuously recorded as a function of temperature or of magnetic field. The resulting data are presented in graphic form. R.T.K.

N64-20700* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
MEASUREMENTS AND THEORETICAL INTERPRETATION OF HALL CURRENTS FOR STEADY AXIAL DISCHARGES IN RADIAL MAGNETIC FIELDS
Philip Brockman, Robert V. Hess, and Richard Weinstein N.Y., AIAA [1963] 16 p refs Presented at the 5th Biennial Gas Dynamics Symp., Phys. Chem. Diagnostics of Plasmas, Northwestern U., 14–16 Aug. 1963
AIAA: $0.50 members, $1.00 nonmembers

Experiments for Hall-ion accelerator are presented using axial electric fields and radial magnetic fields. Measurements of the variation of Hall currents with magnetic field for various constant axial currents are presented together with voltage variations. The pressures in the experiments vary from 6μ to 40μ Hg, the magnetic fields from 0 to 500 gauss, and the currents from 1 to 40 amp. The Hall currents first increase with magnetic field and then decrease again as the magnetic field is increased. The variation can be interpreted in terms of Joule- and ion-slip losses for the partially ionized plasma used in the experiments. The effect of transition to turbulence is also evaluated, and the present state of the theory for turbulent conduction is discussed. Preliminary experiments for preionization and for the heating of ring-shaped cathodes to thermionic emission are discussed. Author

N64-20718 Aerospace Corp., El Segundo, Calif. Materials Sciences Lab.
FLAWS IN RUBY LASER CRYSTALS; GENERAL RESEARCH
K. Janowski and H. Conrad 21 Feb. 1964 8 p ref
(ATN-64(9236)-10)

A description is presented of the microscopic flaws, barely visible to the unaided eye, that were found in some ruby laser crystals. These flaws have the appearance of streaks or filaments. Upon examination of the ruby crystal with an optical microscope, it was found that the streaks or filaments were not continuous but consisted of a large number of closely spaced spheroids (voids or precipitate particles), approximately 2μ in diameter. These spheroids lay along a chord of the original disk boule. Similar streaks or filaments were observed in a 90° ruby rod that was deformed in compression at 1,900° C. These filaments had the same appearance and character as those observed on the as-grown boule and were inclined to the basal plane at about the same angle. Upon etching the deformed sample in fused potassium bisulfate, it was found that many of the filaments terminated at subgrain boundaries. Furthermore, X-ray back reflection studies indicated that the filaments lay along the $\{10\bar{1}1\}$ rhombohedral planes. R.T.K.

N64-20726* Rensselaer Polytechnic Inst., Troy, N.Y.
RADIATION DAMAGE TO SEMICONDUCTORS BY HIGH-ENERGY ELECTRON AND PROTON RADIATION Progress Report, 15 Sep. 1963–15 Mar. 1964

1964 67 p refs
(NASA Grant NsG-290)
(NASA CR-56138) OTS: $6.60 ph

The following topics are covered: (1) cold temperature (90° K to 100° K) irradiation of germanium and silicon with 40-Mev electrons; (2) infrared studies on 40-Mev electron-irradiated silicon; (3) 12 to 52-Mev electron irradiation of silicon and germanium at ~ 300° K; (4) carrier lifetime studies in electron (10 to 55-Mev) and proton (25 to 110 Mev) irradiated germanium; and (5) proton irradiation of germanium at ~ 300° K by 25-and 110-Mev protons. R.T.K.

N64-20732 Baird-Atomic, Inc., Cambridge, Mass.
WIDE BAND COHERENT LIGHT MODULATOR Final Report, Jul. 1962-Jun. 1963
V. del Piano et al Wright-Patterson AFB, Ohio, AF Avionics Lab., Sep. 1963 142 p
(Contract AF 33(657)-9209)
(Rept-4067; ASD-TDR-63-604; AD-421838)

A thorough analysis was made of the theoretical factors affecting Fabry-Perot interferometers containing electro-optical crystals as phase-shifting elements and used as wideband modulators of coherent light. Bandwidth, modulation percentage and distortion, optical transmission, the effect of optical imperfections, and modulator amplifier characteristics are discussed. Descriptions of two experimental modulators based on the results of this analysis are included. The design of a wideband distributed amplifier to drive the final modulator is discussed. The characteristics of this modulator were investigated at low frequencies with a mercury vapor light source and at frequencies up to 30 mc with a continuous gas laser operating at 6,328A. Results of final tests indicate a modulation sensitivity one third of that expected, but a flat pass band out to 30 mc. It is suggested that direct experimental verification of the transmission functions and maximum modulation frequencies be made. Author

26 PROPELLANTS AND COMBUSTION

Includes fuels; igniters; and oxidizers. *For related information see*: 07 Chemistry; and 27 Propulsion.

N64-20125 General Electric Co., Cincinnati, Ohio
EFFECT OF HYDROCARBON FUELS ON THE OPERATION OF VAPOR PHASE FUEL SYSTEMS Technical Documentary Report, Jun. 1962-Apr. 1963
G. G. Kutzko Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Mar. 1964 208 p refs
(Contract AF 33(616)-8224)
(ASD-TDR-62-920; Pt. 2; AD-431315)

Ten hydrocarbon fuels were evaluated in a vaporizing heat exchanger to fuel exit temperatures up to 1,300° F to determine the feasibility of vaporizing fuels prior to combustion as a means of achieving increased heat absorbing capacity of fuels and determining the relationship between fuel properties and performance of a vaporizing system. The heat sinks obtained by use of these fuels were rated. JP-4 (referee), a clay treated furfural extract of light cycle gas oil and pinane plugged the heat exchanger apparatus and are considered unsatisfactory for use as vaporizing fuels. Under conditions of low mass velocities and high pressures, it was possible to obtain high percentages of the theoretical endothermic heat sink capacities from a majority of the fuels tested. However, since these conditions produce low heat-transfer rates, it was not possible to obtain high heat-transfer rates with high endothermic heat sink capacities. Combustion testing did not show significant differences among the fuels tested. Author

N64-20157 Pennsylvania State U., University Park
VORTEX CONTROLLED MULTIFUEL COMBUSTION Final Report, 1 Jun. 1960-31 Oct. 1963
D. A. Willis and W. E. Meyer Oct. 1963 91 p refs
(Contract DA-36-034-ORD-3366T; Contract DA-36-034-AMC-0152T)
(AD-437273)

An investigation was undertaken to determine the effect vortex-type flow has on the multifuel operation of a 3.5-in. bore X 4.5-in. stroke, two-stroke cycle, loop scavenged, air-cooled high-speed compression-ignition engine. The open-type, Lanz-type, and Ricardo-type chambers were investigated, but the most effective results were obtained with a vortex combustion chamber concentric to the cylinder axis and separated from the cylinder by a plate having swirl producing passages around its periphery and a protruding central throat that the piston engaged near TDC. This chamber operated smoothly, efficiently, and at high specific output on a number of fuels at a compression ratio of 25:1 without the necessity of intake air throttling at light load. Author

N64-20177 Monsanto Research Corp., Dayton, Ohio
SURVEY OF RECENT RESEARCH ON FLAME EXTINGUISHMENT Technical Documentary Report, Sep. 1962-Oct. 1963
G. B. Skinner Wright-Patterson AFB, Ohio, Aero Propulsion Lab., Feb. 1964 24 p refs
(Contract AF 33(657)-10304)
(ASD-TR-61-408, Suppl. 2; AD-435541)

Current knowledge in flame extinguishment by chemical and physical agents is reviewed, based on papers published during the period September 1962 to November 1963, in technical journals, trade literature, and Government reports. The survey brings up to date earlier surveys published as ASD TR 61-408, and Supplement 1 to that report. Author

N64-20307 Rohm and Haas Co., Huntsville, Ala. Redstone Arsenal Research Div.
ENGINEERING RESEARCH Quarterly Progress Report, Dec. 10, 1963-Mar. 10, 1964
B. Becker, J. J. Brisbane, T. L. Cost, C. Parr, H. B. Wilson et al 23 Apr. 1964 27 p refs
(Contracts DA-01-021-ORD-11878(Z); DA-01-021-ORD-11909(Z))
(P-64-6; AD-437772)

Progress is summarized for the following projects: Thermal Properties of Propellants, Determination of Curing Kinetics, Analysis of Diffusion Processes Coupled to Chemical Reactions in Solid-Propellant Grains, Analysis of Flow Reactors, Analysis of the DTA Test, Dynamic and Thermal Nonequilibrium in Two-Phase Flow in Rocket Nozzles, Conformal Mapping and Determination of Stresses in Star-Perforated Grains, Development of Approximate Methods of Viscoelastic Stress Analysis, Thermal Stresses in Viscoelastic Materials, Mechanics of Curing Propellants, Mathematics of Composite Materials, Stress Analysis of Infinite Cones Under Axial Acceleration, Analysis of Stress Singularities, Analysis of the Biaxial Strip Test, and Development of Stress Analysis Programs Based on the Finite-Element Method. Author

N64-20472* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
SOME OPTICAL TECHNIQUES FOR TEMPERATURE AND CONCENTRATION MEASUREMENTS OF COMBUSTION IN SUPERSONIC STREAMS
Erwin A. Lezberg and Donald Buchele N.Y., Am. Inst. of Aeron. and Astronautics [1964] 11 p refs Presented at the Aerospace Propulsion Meeting, Cleveland, 4–6 May 1964
(AIAA Paper 64-536) AIAA: $0.50 members, $1.00 nonmembers

Three optical techniques are discussed for determining temperature and species concentration in supersonic streams of combustion products. The three techniques are line reversal pyrometry, determination of the hydroxyl (OH) concentration by spectral line absorption, and determination of carbon dioxide (CO_2) water (H_2O) concentration by infrared spectral absorptance. The line reversal technique, using a locally injected emitter and the OH absorption technique, is illustrated by measurements in a supersonic nozzle. The determination of the infrared emitting species has had some limited demonstration in a shock tube. The limitations of these techniques for measurements in exhaust nozzles and supersonic combustion experiments are examined with reference to temperature, optical depth, and response time. Author

N64-20573 Douglas Aircraft Co., Inc., Newport Beach, Calif. Astropower Lab.
SOLUTION AND CONDUCTIVITY STUDIES IN FLUORINE CONTAINING LIQUID OXIDIZERS Quarterly Progress Report, 10 Dec. 1963-10 Mar. 1964
W. D. English, M. S. Toy, and W. A. Cannon Apr. 1964 27 p refs
(Contract DA-31-124-ARO(D)-115; ARPA Order 470)
(Rept. 144-Q3; AD-437915)

Solution and conductivity studies in fluorine containing liquid oxidizers are discussed. Construction of a gas chromatograph for analysis of the oxidizers was carried out. Conductivity measurements on six liquid fluorides and two binary liquid mixtures were completed. Author

N64-20576* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
RADIATION PROCESSES RELATED TO OXYGEN-HYDROGEN COMBUSTION AT HIGH PRESSURES
Marshall C. Burrows Washington, NASA, 1964 29 p refs For Presentation at the 10th Intern. Symp. on Combust., Cambridge, Engl., 17–21 Aug. 1964
(NASA TM X-52023) OTS: $2.60 ph

Radiation related to the combustion of liquid-oxygen jets in a gaseous hydrogen atmosphere was studied by measuring the intensities of OH, O_2, and H_2O radiation in a combustion chamber equipped with windows. Agreement between the experimental and calculated ultraviolet and infrared radiation data shows that the OH and H_2O radiation within the chamber is in local thermal and chemical equilibrium. Intensities in both spectral regions can be used to determine the required distance to react liquid oxygen with hydrogen. Difficulties in determining ultraviolet intensities can be attributed to heat losses and inadequate homogeneity of the products within the combustion chamber. Rate processes related to the combustion of liquid oxygen and hydrogen, based on a constant temperature reaction with subsequent mixing of the products, are inferred from the data and compare with calculated radiation controlled by turbulent mixing or vaporization. The reaction in the stable combustor appeared to be controlled by turbulent mixing. Vaporization apparently limited the reaction in the unstable chamber. I.v.L.

N64-20622 Federal Aviation Agency, Washington, D.C. Systems Research and Development Service
FLAMMABILITY AND SMOKE CHARACTERISTICS OF AIRCRAFT INTERIOR MATERIALS [Final Report]
John F. Marcy, E. B. Nicholas, and J. E. Demaree Jan. 1964 111 p refs
(FAA-ADS-3)

Flammability and smoke characteristics of interior materials were determined from a selection of 109 materials representative of present usage in the aviation industry. A comparison was made of the flame-resistant characteristics exhibited by the different materials on the basis of: (1) test method, (2) thickness, weight, composition and backing, (3) fire-retardant treatment, and (4) degradation from use and cleaning. From tests, burning characteristics were obtained in terms of burn rate, burn length, and self-extinguishing time. A flame-spread index and smoke factor also were obtained by making use of the Radiant Panel Test Apparatus. Author

27 PROPULSION

Includes airbreathing, electric, liquid, nuclear, and solid propulsion. *For related information see*: 04 Aircraft; 06 Auxiliary Systems; 26 Propellants and Combustion; and 30 Space Vehicles.

N64-20098 Pennsylvania State U., University Park
INVESTIGATION OF A STRATIFIED CHARGE ENGINE EMPLOYING THE AIR SWIRL INDUCED STRATIFICATION PRINCIPLE. THEORETICAL AND EXPERIMENTAL INVESTIGATIONS Interim Report, 9 Mar. 1962-31 Mar. 1964
D. A. Willis Mar. 1964 31 p refs
(Contract DA-36-034-ORD-3638T)
(AD-435855)

On the basis of the experiments conducted, the following conclusions were drawn: (1) Experimental evidence indicates that cylinder injection into an airswirl can be developed to the point where full-load performance will be comparable to that from an externally prepared homogeneous charge. (2) With the combustion chamber and spray-hole orientation used, it was found that the maximum swirl rate obtainable with a shrouded valve must be employed throughout the entire load range. (3) The large spark advance of 25 deg required over the entire load range indicates slow combustion. (4) The optimum injection lead was found to increase with load. (5) Since many parameters (i.e., sparkplug and injector location, spray direction, etc.) remain fixed over the entire load and speed range, it is concluded that a variable airswirl would provide the flexibility needed to achieve success with the swirl stratification process. R.T.K.

N64-20128 Pennsylvania State U., University Park Coll. of Engineering and Architecture
INVESTIGATIONS ON THE INTAKE INDUCED AIR SWIRL OF A STRATIFIED CHARGE ENGINE. EXPERIMENTAL DEVELOPMENT OF A NOVEL STRATIFIED CHARGE ENGINE Technical Report No. 1
Robert A. Taylor May 1963 114 p refs
(Contract DA-36-034-ORD-3638-T)
(AD-408926)

Various methods of generating air swirl in a four-stroke-cycle piston engine cylinder were investigated on a flow model constructed to simulate the engine intake process

under steady flow conditions. The investigation was centered on the production and control of the swirl for a spark-ignited stratified charge engine in which stratification is produced by the interaction of the injected fuel spray with the swirling air in the cylinder. Flow mapping and observations were conducted in the model with paddle wheels, tufted grid, and a hot-wire anemometer. Turbulent intensities were mapped, and transient flows were studied also, using hot-wire techniques. The model flow results were analyzed using basic equations of viscous fluids. This information was then extended to postulate the character of the actual flow in the engine cylinder during compression. The results indicated that the best swirl generation method is one that produces a swirl upstream of the intake valve, but in the direction of the cylinder axis. Author

N64-20182 Air Force Systems Command, Wright-Patterson AFB, Ohio Flight Dynamics Lab.
DESIGN ANALYSIS SUMMARY OF TWO FORCE-BALANCE HYPERSONIC INLET CONFIGURATIONS
Paul H. Kutschenreuter, Jr., Richard L. Balent, and George K. Richey Mar. 1964 47 p refs
(FDL-TDR-64-19; AD-437909)

Two hypersonic inlet models were designed for force balance testing in a 48-in. shock tunnel over a Mach number range of 8 to 16. The performance of these models is to be established experimentally on the basis of their measured internal drag. Reasons for considering this method of establishing hypersonic inlet performance and use of the associated "drag equivalent" pressure recovery are discussed. The design of these models, the resulting inlet geometry, and the related performance calculations are described. Author

N64-20239 Thiokol Chemical Corp., Brigham City, Utah Wasatch Div.
A METHOD OF EMBEDDING ACCELEROMETERS IN SOLID PROPELLANT ROCKET MOTORS
R. L. Allen and L. R. Flippin *In* Defense Dept. Shock, Vibration and Assoc. Environ., Pt. 3 Mar. 1964 p 27–43 This paper not presented at the symp. (See N64-20235 13-01)

Extensive engineering studies were made to determine the minimum number, location, and type of accelerometers required to describe the dynamic response of the propellant. A technique was developed for controlling the position and orientation of the accelerometers when embedded in the motor propellant. A laboratory research program was conducted to develop reliable bond joints. The configuration finally selected utilizes 24 triaxial accelerometers, of which 14 are embedded in the propellant and 10 are mounted on the propellant surface. The accelerometer and cable assemblies are precast in propellant wedges that are bonded in the case prior to casting the motor. Piezoelectric accelerometers were selected in order to meet the dynamic response, safety, density, and temperature specifications. Author

N64-20267 Picatinny Arsenal, Dover, N.J.
DESCRIPTION OF LAW SYSTEM AND CONTROL OF EROSION IN ROCKET MOTOR Technical Memorandum 1330
Seymour Kaplowitz Jan. 1964 33 p
(AD-429155)

One of the newest limited-war weapons in the Army inventory is the 66-mm LAW M72. It is a lightweight shoulder-fired rocket that provides the individual infantryman with close-in antitank defense and the ability to deflect hard targets. It is a single-shot throwaway weapon. The launcher serves as the protective package for the rocket until the weapon is opened and fired, after which the launcher can be discarded. Problems connected with the production and development of this weapon are discussed along with control of erosion in the LAW rocket motor. A test program was conducted to isolate the cause of heavy erosion in the convergent section of the fired motor, and to determine the extent to which propellant, igniter, and metal parts were contributory factors. R.T.K.

N64-20283* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
ANALYTICAL INVESTIGATIONS OF COIL-SYSTEM DESIGN PARAMETERS FOR A CONSTANT-VELOCITY TRAVELING MAGNETIC WAVE PLASMA ENGINE
Raymond W. Palmer, Robert E. Jones, and George R. Seikel Washington, NASA, May 1964 38 p refs
(NASA TN D-2278) OTS: $1.00

Results of an analytical study of the design parameters are presented for a simple method of producing a traveling magnetic wave—to excite a linear array of coils with polyphase radiofrequency electric current. Equations that describe axial and radial components of the magnetic field are developed with the presence of a plasma neglected. The approximate equations are valid for a value of the accelerator-to-coil radius ratio as large as 0.5. A Fourier decomposition of the total magnetic wave shows that this wave is composed of an infinite series of waves of diminishing amplitude running opposite to each other at different velocities. The presence of magnetic waves other than the design magnetic wave, as well as the variation of the average magnetic intensity level, forms the basis for the definition of a quality factor for comparison to other coaxial coil systems. The quality factor is an approximate scaling law and indicates that properly designed larger coil systems will produce the magnetic energy more efficiently than smaller systems. Author

N64-20348 Naval Ordnance Lab., White Oak, Md.
HIGH TEMPERATURE RESISTANT MATERIALS FOR MISSILE PROPULSION SYSTEMS Summary Report, 30 Jun. 1962-30 Jun. 1963
F. J. Koubek 29 Nov. 1963 46 p refs
(NOLTR-63-255; AD-433223) OTS: $4.60

Progress made in an ablation materials study program is described. The "alpha-rod" automatic feed device was modified to reduce its response time and to improve on the ablation record. A tendency to overfeed the specimen was caused by component misalignment. Preliminary arc image tests demonstrated the importance of environment. The rate of char removal from phenolic-nylon was greatly increased by the presence of flowing gas. Diminished ablation of phenolic-refrasil in carbon dioxide flow was due to cooling of the outer periphery. Modified phenolic resin systems continued to perform well in oxy-acetylene screening tests. Two component refractory filled phenolics did poorly in low-velocity solid rocket tests. Further work was done to demonstrate the potential of silicone rubber as the matrix for effective, elastomeric insulators. Four out of seven groups agreed closely in an oxyacetylene ablation test program. On-site observations were made to correct deficiencies. A common problem was low heat flux due to worn torch tips. Author

N64-20371 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
USE OF THE INTEGRAL CRITERION IN CERTAIN CONTROL PROBLEMS

B. A. Aref'ev 16 Dec. 1963 12 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedeniy, Priborostr. (Leningrad), v. 6, no. 1, 1963 p 47–53
(FTD-TT-63-1111/1+2+4; AD-429229)

A possible method of calculating the integral energy is presented. Examples are given of using the corresponding criterion for certain control problems. A relationship is shown between the criterion under consideration and the usual integral estimates of quality. Author

N64-20519 Franklin Inst., Philadelphia, Pa. Labs. for Research and Development
RADIOISOTOPE SHIELDING DESIGN MANUAL
William H. Steigelmann Washington, AEC, Div. of Tech. Inform., Jul. 1963 142 p refs
(Contract AT(30-1)-3042)
(NYO-10721) OTS: $2.50

A method of calculation of the radiation dose rate from a radioisotope source makes use of 2 types of curves—one giving the unshielded dose rate per curie of source activity as a function of distance from the source, and the other presenting a dose attenuation factor as a function of shield thickness. This method of calculation is described for gamma radiation, bremsstrahlung, and neutrons. The radiation dose-rate curves and shield-attenuation curves are presented in 16 sets of figures, each set presenting information on one group of radioisotopes. Some examples of the use of the curves are included. R.T.K.

N64-20578* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
OFF-DESIGN PERFORMANCE OF HYPERSONIC SUPERSONIC COMBUSTION RAMJETS
Leo C. Franciscus Washington, NASA, 1964 11 p refs For Presentation at the 1st Ann. Meeting and Tech. Display of the Am. Inst. of Aeron. and Astronautics, Washington, 28 Jun.–2 Jul. 1964
(NASA TM X-52032) OTS: $1.60 ph

A performance study of fixed-geometry two-dimensional supersonic combustion ramjets was undertaken to determine the relative importance of various losses and the effect of engine geometry on them. Results of the study have shown that friction losses are large and can account for as much as 34-percent reduction in fuel specific impulse at Mach 20. Nozzle dissociation losses are relatively small and amount to 6 percent of the ideal specific impulse at Mach 20. The performance tradeoffs indicate that the avoidance of large inlet shock and nozzle divergence losses by using small inlet wedge and nozzle divergence angles result in large viscous losses. Author

N64-20579* Thompson Ramo Wooldridge, Inc., Cleveland, Ohio New Products Research Group
RESEARCH AND DEVELOPMENT OF PROPELLANT FEED SYSTEMS FOR ION ENGINES [NOV. 1961-SEP. 1962]
Patrick J. Lawlor and Keith M. Montgomery Washington, NASA, May 1964 123 p refs
(NASA Contract NAS8-2525)
(NASA CR-51) OTS: $2.75

The cesium fuel system reviewed in this report consists of those components necessary to store, meter, and vaporize cesium, to allow delivery of the vapor at the flow rate, pressure, and temperature consistent with the general requirements of contact ion propulsion devices now under investigation. Presented in this report are the results of compatibility and handling studies for cesium, design and development of separate system components, and integration of components into a working laboratory system. Experimental test results indicating the system performance are also presented. Author

N64-20712* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
THRUST MEASUREMENTS OF COLLOIDAL PARTICLES AS AN INDICATION OF PARTICLE SIZE AND THRUSTOR OPERATION
Daniel S. Goldin and Carl T. Norgren N.Y., AIAA [1963] 18 p refs Presented at the AIAA Elec. Propulsion Conf., Colorado Springs, 11–13 Mar. 1963
(AIAA Paper-63-050)

Thrust measurement and its correlation to the operational characteristics of an experimental colloidal-particle thrustor are discussed. Measurements were made on a previously designed condensation colloidal-particle electrostatic thrustor with mercurous chloride as the propellant. Thrust measurements of the order of 1 to 10 mg were made with a modified electric microbalance calibrated to a sensitivity of 10^{-4} to 10^{-5} gram. As anticipated from the classical liquid-drop theory of nucleation, no thrust was observed until a viscous flow regime and subsequently a critical nucleation rate was obtained in the nozzle. This condition corresponds to a vaporizer temperature of 485° K. With the assumption of singly charged colloids, a mean particle size of 1.2×10^6 amu would be required to account for measured target deflections at a vaporizer temperature of 490° K. From an electron photomicrograph of the colloidal beam at similar operating conditions, a mean particle size of 1.71×10^6 amu was indicated. Author

N64-20713* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
ELECTRIC BREAKDOWN AND ARCING IN EXPERIMENTAL ION THRUSTOR SYSTEMS
John B. Stover N.Y., AIAA 1963 17 p Presented at the AIAA Elec. Propulsion Conf., Colorado Springs, Colo., 11-13 Mar. 1963
(AIAA Paper-63057-63) AIAA: $0.50 members, $1.00 nonmembers

The importance of breakdown and arcing phenomena in ion thrustors arises both from the necessity to cluster modules to obtain useful thrust levels and from the probable advantages of the electrical paralleling of modules on a minimum number of power supplies. An experimental program was undertaken to identify the breakdown and arcing phenomena in an electron-bombardment ion thrustor. Breakdown between the accelerating electrodes was observed below the levels determined by other investigators for either field emission from clean surfaces or sparking with surfaces contaminated by vacuum-pump oil, and well below the withstand voltage of the insulators. Following breakdown, self-extinction of low-current arcs frequently occurred, as expected from published reports on the instability of d.c. vacuum arcs. A considerable percentage of the breakdowns, however, developed into sustained arcing. The low breakdown potential and the persistence of some low-current arcs both suggest the presence of contaminants on the electrodes. Luminous prebreakdown discharges observed at the electrodes tend to confirm the presence of contaminants. Author

N64-20719 Aerojet-General Corp., Sacramento, Calif. Solid Rocket Plant
15-IN.-DIA SPHERICAL SOLID-ROCKET-MOTOR PROGRAM Final Report
13 Mar. 1964 71 p refs Prepared for MIT
(Rept. 3868-01F)

The objective of this program was to develop a high-performance unit for specific application to the Trailblazer II reentry physics research rocket vehicle. Of 21 motors processed, 7 were statically fired. Four were statically fired while spinning. The desired performance requirements for the motor were

achieved during sea-level static firings. Subsequent firings while spinning resulted in flight-weight motor-chamber burnthroughs late in the tailoff portion of the firing. Firing data inconsistencies did not permit clear definition of the effects of spinning on motor performance. Also, some unbonding of the nozzle liner, attributed to the use of altitude nozzles at sea-level conditions, occurred during these tests. R.T.K.

28 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. *For related information see*: 05 Astronomy and Astrophysics; 16 Life Sciences; and 29 Space Sciences.

N64-20106 Denver U., Colo. Colorado Seminary
RADIANCE OF THE EARTH IN SELECTED WAVELENGTH INTERVALS AS OBSERVED FROM HIGH ALTITUDES Final Report
David G. Murcray 31 Mar. 1964 223 p
(Contract AF 33(616)-7633)
(DRI-2149; AFCRL-64-165; AD-437632)

This report presents the data concerning the radiance of the earth in the 2.7μ and 4.3μ wavelength region as observed from an altitude of 31 kms. These data were obtained on a number of balloon flights made with an automatic radiometer system. The results are compared with the results predicted on a theoretical basis. These comparisons indicate fairly good agreement with some of the theoretical results; however the maximum radiances observed in the 2.7μ region exceed the predicted radiances by several orders of magnitude. Author

N64-20183 Kiruna Geophysical Observatory (Sweden)
AN INVESTIGATION OF THE NATURAL ELECTRO-MAGNETIC RADIATIONS BETWEEN 10 c/s AND 10 kc/s Scientific Report No. 5
Alv Egeland, Georg Gustafsson, Sven Olsen, William Barron (AFCRL), and Alan Katz (Boston U.) 20 Feb. 1964 42 p refs
(Contract AF 61(052)-678)
(AFCRL-64-304; AD-437820)

Naturally occurring electromagnetic radiation in the audio-frequency range was studied. The results were compared with similar measurements at Sagamore Hill, Mass. Several emission bands, distinct from the normal background-signals, and obtained as strong enhancements in portions of the spectrum, were recorded. The frequency of the maximum intensity of the emission is approximately 700 cps. No marked diurnal, seasonal, or yearly shift of the frequency, of maximum amplitude, was observed. The amplitude of the emission at 700 cps is well above the noise level. In more than 90% of all events, the average half-intensity bandwidth of the 700 cps peaks varied between 500 and 1,000 cps. Definite 700 cps radiation was observed only in the auroral zone. A marked asymmetrical shape of the 700 cps emission pulses was observed. Emission at 700 cps is produced by a physical process (or processes), different from that which produces other VLF emissions. Received signals probably consist of electromagnetic emissions, which propagate in the extraordinary mode along the lines of force of the earth's magnetic field. The hypothesis that these 700 cps signals are generated outside the E-layer, by the arrival of protons, is discussed. Author

N64-20358 RAND Corp., Santa Monica, Calif.
SOLAR SYSTEM SCIENCE BIBLIOGRAPHIES
Edna O'Connell Jan. 1964 52 p refs
(P-2859; AD-429110)

This paper is an annotated bibliography of bibliographies of scientific disciplines related to the solar system covering the period from 1961 to 1963. The subjects included are: atmospheric physics, interplanetary physics, the moon, the planets, and bibliographies related to solar system science in general. R.T.K.

N64-20468 Library of Congress, Washington, D.C. Aerospace Information Div.
SKY ILLUMINATION DURING ECLIPSE. ANNOTATED BIBLIOGRAPHY OF SOVIET-BLOC LITERATURE FOR THE PERIOD 1940-1963
17 Apr. 1964 72 p refs
(AID-B-64-20; AD-439226) OTS: $7.60 ph

This is an annotated bibliography of Soviet-bloc materials on sky illumination during solar eclipses (sky brightness, light polarization, and photometry of the corona) published since 1940. The items describe photometric investigations of the eclipses of 19 June 1936, 21 September 1941, 9 July 1945, 25 February 1952, 30 June 1952, 2 December 1956, 19 April 1958, 2 October 1959, and 15 February 1961. Author

N64-20471 Chicago U., Ill. Enrico Fermi Inst. for Nuclear Studies
RECENT INVESTIGATIONS OF THE LOW ENERGY COSMIC AND SOLAR PARTICLE RADIATIONS Pontifical Academy of Science's Scripta Varia No. 25
J. A. Simpson Vatican, Pontifical Acad. of Sci., 1963 30 p refs Repr. from "Semaine d'Etude sur le Probleme Du Rayonnement Cosmique dans l'Espace Interplanetaire"
(Contracts AF 49(638)-1008; AF 19(604)-4554; AF AFOSR Grant 62-23)
(AFOSR-64-0632; AD-434654)

A preliminary study was made of changes in intensity and spectrum of the solar-modulated cosmic radiation over a solar activity cycle. Neutron intensity monitors responsive to changes in primary particle magnetic rigidity as low as ~1 Gv have been analyzed for the period 1952–1962. The experimental results are explained by the growth and decay of a modulating electrodynamical region bounding a large volume of interplanetary space. Recent experiments by Meyer and Vogt to study the origin of 80 to 350 Mev primary protons shown to be continuously present during years near maximum solar activity are discussed, as are the alternatives for their solar origin. Author

N64-20491 Stanford Research Inst., Menlo Park, Calif.
SUDDEN IONOSPHERIC DISTURBANCES AND THE PROPAGATION OF VERY-LOW-FREQUENCY RADIO WAVES. PART 1: PHENOMENOLOGY AND RELEVANT IONOSPHERIC THEORY Final Report
Edward T. Pierce and Helen R. Arnold Jul. 1963 157 p refs
(Contract AF 49(638)-1081; ARPA Order 159-61, Amend. 7)
(AD-428169)

Accomplishments cited include: (1) A survey was made of the changes in VLF radio noise accompanying a solar flare and its association with sudden ionospheric disturbances (SID). The onset time of the effects is about 10 minutes, but may be less than 2 minutes for perhaps 5% of the incidents. If a local thunderstorm develops, the time phasing is very similar to that of an SID incident, but noise at all frequencies is enhanced. (2) A detailed examination was made of the formative processes

of the lower ionosphere. Values of the rate coefficients for attachment, detachment (photo, collisional, and associative), electron–ion recombination, and ion-ion recombination are deduced for heights from 40 to 100 km. Over the same height range, the ionization contributions due to the major influences of cosmic rays, solar X-rays, and solar Lyman α are examined. The balance equations for the lower atmosphere are solved for the cases of equilibrium conditions and of the departure from equilibrium associated with the approach of night. (3) A model of the solar X-ray flux during a flare was derived, and its ionizing effects were examined. The flux peaks in 5 minutes, but the maximum ionospheric effect lags behind, especially at lower ionospheric heights. (4) The ionization produced by an X-ray burst from a nuclear explosion in space was deduced. I.v.L.

N64-20584* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A PROBE FOR THE INTERPLANETARY PLASMA
K. W. Ogilvie, N. Mc Ilwraith, H. J. Zwally, and T. D. Wilkerson (Maryland U.) June 1963 23 p refs Presented at 6th Intern. Conf. on Ionization Phenomena in Gases, Paris, 8 Jul. 1963
(NASA Grant NsG-283)
(NASA TM X-51042) OTS: $2.60 ph

The energy distributions of protons and other species of ions in interplanetary space as well as at satellite altitudes will be studied using a new detection technique. The instrument, which is 10 × 30 × 20 cm^3 in size, contains an electrostatic energy analyzer, a secondary-electron-scintillation detector, high-voltage supplies, and signal conditioning circuits. Laboratory work demonstrates constant response for protons having energies from 30 ev to 3 Kev and a minimum detectable current corresponding to about 10 particles per second. Progress is reported on the development of a velocity selector for separating ionic species, hopefully leading to the solution of an important problem in solar wind studies: the determination of the relative abundance of protons and alpha particles. Author

N64-20590* Maryland U., College Park
THE SPECTRUM AND COMPOSITION OF HIGH ENERGY COSMIC RAYS Technical Report No. 368
Howard Laster Mar. 1964 7 p refs
(NASA Grant NsG-58-60)
(NASA-CR-56025) OTS: $1.10 ph

Recent experimental results have supplied data necessary to distinguish between alternative theories of the origins of cosmic rays. These results are compared with predictions of a diffusion model for the propagation of cosmic rays, and possible future observations are suggested. R.T.K.

N64-20631* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
FAST NEUTRONS IN THE EARTH'S ATMOSPHERE. I. VARIATION WITH DEPTH
Robert C. Haymes Repr. from J. Geophys. Res., v. 69, no. 5 1 Mar. 1964 p 841–852 refs
(NASA Contract NAS7-100)
(NASA CR-56082; JPL-TR-32-539)

A series of balloon flights at $\lambda = 41°$ N to atmospheric depths of about 3.6 g/cm^2 were conducted in 1963. A phoswich type of scintillation counter, which has a high efficiency for neutrons in the 1- to 14-Mev range of energies, was employed. Gamma rays and charged particles are distinguished through pulse-shape discrimination and are separately telemetered. The experiments revealed that the mean free path for absorption in the lower atmosphere was 169 ±13 g/cm^2, and that the neutron flux at the 90-g/cm^2 transition maximum was 1.1 neutrons/cm^2 The flux at the highest altitudes attained was 0.39 n/cm^2 sec, and an extrapolation to the top of the atmosphere that follows Newkirk's theory yields 0.24 ±0.02 n/cm^2 sec for the neutron flux at the boundary. The absolute values are accurate to ±20 percent. Author

29 SPACE SCIENCES

Includes space chemistry; cosmology; lunar and planetary exploration; and theoretical analysis of orbits and trajectories. *For space biology see*: 16 Life Sciences. *For related information see*: 05 Astronomy and Astrophysics; 12 Geophysics; and 22 Navigation and Guidance.

N64-20191* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MONTE CARLO COMPUTATION OF THE STATISTICS OF THE MIDCOURSE VELOCITY CORRECTIONS FOR A LUNAR MISSION
Gerald L. Smith and Burnett L. Gadeberg Washington, NASA, May 1964 39 p refs
(NASA TN D-2296) OTS: $1.00

A Monte Carlo method is described for obtaining the statistics of the total velocity correction employed in the multicorrection midcourse guidance of a space vehicle. The problem is analyzed to show the statistical correlation that exists between successive corrections, and to develop equations necessary for implementing a Monte Carlo computer program. Covariance matrices of the individual corrections, computed by means of prior simulation of the problem, are required as inputs to the program. Results are given for the application of the technique to the midcourse guidance phase of a circumlunar flight having five velocity corrections. Analysis of the results indicates that commonly used estimates of fuel requirements from calculated rms velocity corrections may result in an excessive fuel load. Author

N64-20315 RAND Corp., Santa Monica, Calif.
HABITABLE PLANETS FOR MAN
Stephen Dole Mar. 1964 170 p refs
(Contract AF 49(638)-700; Proj. RAND)
(R-414-PR; AD-437264)

Discussed are man's nonterrestrial destinations rather than methods of propulsion or other technical problems of space travel. Habitable planets are studied in terms of human requirements of temperature, light, gravity, atmosphere, water, and food. The solar system and beyond are surveyed as possible candidates. Impelling reasons are given for human emigration to other planets. R.T.K.

N64-20376 RAND Corp., Santa Monica, Calif.
CHARTS FOR DETERMINING THE CHARACTERISTICS OF BALLISTIC TRAJECTORIES IN A VACUUM
Deane N. Morris Apr. 1964 75 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3752-PR; AD-439074)

Presented is a summary of information on the trajectories of ballistic vehicles traveling in a vacuum about a nonrotating, spherical earth. The graphs presented permit accurate determination of important parameters of unpowered flight outside the atmosphere, including the range, time of flight, apogee altitude, terminal velocity, and terminal flight-path angle, all as functions

of the burnout velocity, the burnout angle, and the burnout and terminal altitudes. Charts are given for quickly establishing the values of velocity, flight-path angle, time, and range along the trajectory. The range of variables examined includes burnout altitudes from 400,000 to 1,000,000 ft, burnout velocities from 2500 fps to escape velocity, and burnout flight-path angles between −30° and 90°. Many of the graphs are presented in "carpet-plot" form to aid in interpolation and in visualizing the trends of the parameters. Author

N64-20391 Massachusetts Inst. of Tech., Cambridge
ANGULAR MOMENTUM FLUX IN THE FORMATION OF THE SOLAR SYSTEM Scientific Report No. 5
Norman E. Gaut 1 Feb. 1964 149 p refs
(Contract AF 19(628)-2408)
(AFCRL-64-167; AD-438007)

A comprehensive historical review of theories explaining the origin of the solar system is presented. The concept of gravitational torques and eddy transfer of angular momentum in a hypothetical model of a solar nebula is introduced. It is found that if a spiral asymmetry of the mass distribution is present, the gravitational torques of particles outside an imaginary radial wall on those inside tend to draw angular momentum radially-outward. The eddy transport of angular momentum for the same distribution is found to be inward. The magnitude of the gravitational torque appears to dominate the advective rate of angular momentum flux but by less than one order of magnitude. Author

N64-20643* IIT Research Inst., Chicago, Ill. Astro Sciences Center
SURVEY OF A JOVIAN MISSION Report No. M-1
W. O. Davies, F. Narin, D. L. Roberts, L. A. Schmidt, L. C. Scholz et al Mar. 1964 90 p refs
(NASA Contract NASr-65(06))
(NASA CR-53987; M1) OTS: $8.10 ph

A survey of the requirements for Jovian missions was made. Scientific questions concerning Jupiter were used to select minimum experimental payloads to increase knowledge of the planet. Approximate payload weights were derived from instrumentation estimates, data handling and transmission requirements, electrical power demands, guidance and control requirements, spacecraft structure, shielding, and terminal maneuver energy needed. Three launch vehicles were postulated with performance sufficient to cover the range expected in the next decade. The requirements for additional propulsion, and the launch restrictions associated with Jovian missions were assessed on the basis of these three vehicles. The addition of a final stage for injection to transfer orbit is necessary to achieve most missions. The characteristics of a hypothetical high-performance stage were derived for several combinations of mission parameters. Author

N64-20724* New York U., N.Y. Geophysical Sciences Lab.
PROJECT HIAM [A THEORETICAL INVESTIGATION OF THE PROPERTIES OF PLANETARY ATMOSPHERES] Progress Report, 1 Jul.-31 Dec. 1963
James E. Miller 15 Jan. 1964 9 p refs
(NASA Grant NsG-499)
(NASA CR-56134) OTS: $1.10 ph

Progress reported includes the following: (1) A model for studying breaking atmospheric waves was developed. It consists of a two-layer fluid resting on a solid, nonrotating parabolic surface. Thereby, the model can approximate a wave propagating over a mountain. The computations to determine the initial breaking point of an internal gravity wave initiated in such a model are being carried out on an IBM-7094 computer. (2) A literature search was conducted on the size distribution, height distribution, and composition of the atmospheric aerosol particles. Junge found that, in the range of the optically significant particles, the size distribution of particles followed a simple inverse power law. His chemical analysis of the aerosol showed the NH_4 and SO_4 radicals to be the most common. Fenn found that the aerosol does not follow a continuous distribution, as Junge found, but occurs in discrete size ranges. The magnitude of these discrete distributions depends on time and locality. However, the peaks of the discrete concentrations were found to lie along the line of the profile as found by Junge. I.v.L.

N64-20734* Florida State U., Tallahassee
POLARIZATION OBSERVATIONS OF JUPITER AT DECAMETER-WAVELENGTHS
C. H. Barrow [1964] 34 p refs Submitted for Publication
(NASA Grant NsG-224-61)
(NASA-CR-53538) OTS: $3.60 ph

The polarization of radiation from Jupiter was studied at frequencies of 16, 18, 22, and 26 mc/s. Data was analyzed burst-by-burst, and the results are tabulated in detail for 3,800 bursts. Histograms of occurrence probability and numbers of bursts were prepared for each frequency. In general, for the period of the observations, most of the radiation at 22 and 26 mc/s was right-handed polarized, whereas at 16 and 18 mc/s an appreciable proportion of bursts were left-handed. The changes in polarization mode observed from one frequency to another may indicate magnetic and ionospheric conditions on Jupiter and allow parameters to be deduced to within narrow limits. Daily polarization variations may be due to magnetic disturbances on Jupiter, and thus may be associated with solar activity. A search should be made for long term variations caused by changes in the electron density of the Jovian ionosphere and associated with the sunspot cycle. Author

30 SPACE VEHICLES

Includes launch vehicle-spacecraft combinations; missile systems; operating problems; safety devices; and stability and control. *For boosters and launch vehicles see*: 31 Space Vehicles (Launch Vehicles). *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N64-20021 Avco Corp., Wilmington, Mass. Research and Advanced Development Div.
PROJECT VOYAGER, VOLUME I Status Report No. 2, Sep. 1962-Feb. 1963
W. P. Neacy and A. Kahane 24 May 1963 419 p refs
(RAD-TM-63-17, Vol. 1)

This report documents the results of a parametric study effort directed toward a dual payload mission, both an orbiter and lander launched toward Mars and Venus. A general Voyager system analysis is presented. In particular, studies of and tradeoffs between scientific payload, communications, power supply, guidance and control, and atmospheric entry were performed. These studies are integrated into conceptual designs of spacecrafts and landers. Author

N64-20084 Bendix Corp., Southfield, Mich.
APPLICATION OF HIGH MOMENT-PRODUCING TECHNIQUES FOR CONTROL OF A MANNED SPACE VEHICLE Final Report

R. H. Larson Wright-Patterson AFB, Ohio. Flight Dynamics Lab., Mar. 1964 402 p refs
(Contract AF 33(657)-10998)
(FDL-TDR-64-32; AD-439201)

This study is concerned with the application of high moment-producing techniques for attitude control of manned space vehicles, performing orbital transfer, rendezvous, and lifting reentry maneuvers. Control system, subsystem, and component requirements for critical vehicle flight phases were established. Promising techniques for performing the flight control functions required during various maneuvers were analyzed. A hypothetical vehicle was selected, and its space mission was analyzed to determine the attitude control requirements. The rendezvous and reentry maneuvers were especially demanding on the attitude control system. The production of control moments by reaction wheels, gyros, mass expulsion, secondary injection thrust vector control, and aerodynamic surfaces was investigated. Reaction engines, secondary injection thrust vector control, and aerodynamic flaps were selected for use in the required attitude control systems, and specific designs were made. The control loops were analyzed regarding response, accuracy, and fuel consumption. A substantial amount of this analysis was accomplished by analog computer simulation. Author

N64-20118 Air Force Special Weapons Center, Kirtland AFB, N. Mex. Test Div.
RANGE SAFETY REPORT. AEROSPACE ENVIRONMENTAL RESEARCH PROGRAM, SLV-1B VEHICLE
Albert L. Haley and James H. Raddin Jan. 1964 98 p refs (SWC(SLV-1B)RSR-1A; supersedes SWC(SLV-1B)RSR-1; AD-428942)

This document describes, in detail, the performance characteristics of the SLV-1B vehicle, the three-sigma dispersion analysis, wind effects, failure occurrences, the destruct dynamics, reentry heating, and tracking equipment. Author

N64-20149 Bendix Corp., Southfield, Mich. Research Labs. Div.
APPLICATION OF HIGH MOMENT-PRODUCING TECHNIQUES FOR CONTROL OF A MANNED SPACE VEHICLE
Summary Final Report
R. H. Larson et al Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Mar. 1964 60 p For abstract see N64-20084 13-30
(Contract AF 33(657)-10998)
(FDL-TDR-64-32; AD-439202)

N64-20242 Lockheed Missiles and Space Co., Sunnyvale, Calif.
THE USE OF STRAIN GAGES TO DETERMINE TRANSIENT LOADS ON A MULTI-DEGREE-OF-FREEDOM ELASTIC STRUCTURES
F. R. Mason *In* Defense Dept. Shock, Vibration and Assoc. Environ., Pt. 3 Mar. 1964 p 63–68 This paper was not presented at the symp. (See N64-20235 13-01)

The procedure outlined was first formulated in connection with attempts to arrive at an optimum design for a recovery pole used on aircraft as part of a rig to effect the aerial recovery of parachute-borne reentry capsules. It was considered practical to extend this technique to the experimental determination of distributed transient loadings on other types of elastic structures, such as missiles or aircraft, or plate structures. Two poles inclined downward and outward are cantilevered from the rear of the aircraft to support the rigging, and the technique of recovery is for the pilot to make a pass over the parachute and snag it in the rigging. In many cases, the 'chute collides with one of the poles and bends or breaks it, sometimes resulting in the loss of the payload. To carry out a theoretical analysis to determine the response of the pole to parachute impact, a knowledge of the nature of the time and position varying load that the 'chute applies to the pole during the contact period is necessary. Author

N64-20248 McDonnell Aircraft Corp., St. Louis, Mo.
DYNAMIC MOORING TESTS OF ONE-QUARTER SCALE MODELS OF THE GEMINI AND AGENA SPACECRAFT
N. E. Stamm and L. A. Priem *In* Defense Dept. Shock, Vibration and Assoc. Environ., Pt. 3 Mar. 1964 p 97–99 refs (See N64-20235 13-01)

Some of the problems that evolved from this test included the design and fabrication of dynamically scaled models, development of zero-g suspension systems, and control of the relative model attitudes and velocities at impact. The 1/4-scale mooring test provided data that substantiated initial design concepts and established mooring parameters that must be maintained for a successful mooring of the two spacecraft. Author

N64-20320 General Dynamics/Astronautics, San Diego, Calif.
DYNAMICS OF THE ATLAS 5-CPS LONGITUDINAL OSCILLATION FOLLOWING LAUNCH AS RELATED TO THE TANK PRESSURE REGULATION SYSTEM. VOLUME II: PNEUMATIC SYSTEM MODEL DEVELOPMENT
R. G. Rose 31 Dec. 1963 71 p refs
(Contracts AF 04(694)-196; AF 04(694)-240)
(GDA63-0712; AD-435037)

The results of the pneumatic system model development necessitated by a 5-cps longitudinal oscillation study in support of LV-3B (Project Mercury) and SLV-3 are reported. The 5-cps oscillation is discussed in terms of coupling between the vehicle–fluid structure and the pneumatic tank pressure regulation system. In particular, the divergent cases cited are interpreted to represent an instability of the pneumatic pressure regulation system. The dynamic response of the various fluid elements of the pneumatic pressure regulation system is defined for Atlas. These include the pressure sensing line, the helium supply duct, the pneumatic pressure regulator, and the tank ullage for each propellant tank. The feedback control loop involved is one that transmits the tank ullage pressure to the regulator by means of a sensing line. In response, the regulator modulates the helium weight flow into the tank. The tank ullage pressure also acts as a force to the vehicle structure. R.T.K.

N64-20463 Aerospace Corp., El Segundo, Calif. Applied Mechanics Div.
THE EFFECTS OF THE ACCURACY OF ATMOSPHERIC DATA ON THE STRUCTURAL DESIGN LOADS OF A TYPICAL LAUNCH VEHICLE
J. S. Field and D. E. Hargis 20 Apr. 1964 45 p
(Contract AF 04(695)-269)
(SSD-TDR-63-383; TDR-269(4304)-6; AD-437972)

This report documents the effects of simulated inaccuracies of meteorological data on the structural loads of two types of launch vehicles. The effects of inaccuracies ranging from +10% to −10% of atmospheric density, atmospheric temperature, windspeed, wind shear, and wind-shear length were studied. The two launch vehicles used were a liquid-propellant boosted vehicle and a relatively small solid-propellant boosted vehicle. Author

N64-20492* National Aeronautics and Space Adminstration, Washington, D.C.
NASA TO LAUNCH SIXTH SATURN I News Release No. 64-113

20 May 1964 52 p
Available from the Scientific and Technical Information Div.

According to NASA, the main purpose of the sixth Saturn I flight is to qualify the launch vehicle further, and to develop the technology necessary to build the more powerful Saturns needed for manned lunar landing and other space exploration. Secondary missions include determining the structural characteristics of the launch escape system, the operational suitability of Atlantic Missile Range ground tracking stations, and the launch escape-system jettison characteristics, as well as demonstrating the compatibility of spacecraft research and development instrumentation and communication systems with launch vehicle systems. Detailed background information on SA-6 (sixth Saturn I flight vehicle) is presented and includes: flight sequence, the SA-6 satellite, measuring program, Apollo spacecraft, vehicle background and description, launch complex, launch preparations, optical systems, tracking network, and Saturn–Apollo industrial participation. R.T.K.

N64-20537 Sandia Corp., Albuquerque, N. Mex.
RE-ENTRY FLIGHT DEMONSTRATION NUMBER ONE (RFD-1): COMPARISON OF THE PREFLIGHT AND OBSERVED TRAJECTORIES
H. R. Spahr Apr. 1964 62 p refs
(SC-RR-64-510) OTS: $1.75

Theoretical preflight trajectories are presented for the RFD-1 reentry system and launch vehicle. The reentry system consisted of the SNAP-10A Simulated Test Reactor (STR) and the reentry vehicle (RV); the launch vehicle was a four-stage NASA Scout. Possible dispersion in the trajectory of the reentry system, resulting from dispersion in the trajectory of the launch vehicle, is discussed. Data from the RFD-1 flight defining the trajectories of the reentry system and the launch vehicle are also presented. Good correlation between the observed data and the theoretical postflight reentry system trajectory is shown. Author

N64-20550* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SOME SOURCES OF GROUND-WIND LOADS IN LAUNCH VEHICLES
Donald A. Buell [1963] 16 p refs
(NASA TM X-54024) OTS: $1.60 ph

The potential sources of oscillations in launch vehicles, induced by ground winds, were investigated using models in a steady wind. Results show that the following caused large oscillations: (1) single conduits; (2) an umbilical tower; and (3) blunt noses. Model motion and roughness accentuate the wind excitation in certain cases. I.v.L.

N64-20554 Weapons Research Establishment (Australia)
RE-ENTRY OF SPACE VEHICLE FRAGMENTS. INTERIM OF THE ANALYSIS OF THE "BOULLIA BALL"
P. M. Twiss Jan. 1964 17 p refs
(WRE-TN-36)

A description is given of a light metal sphere found in a remote part of Australia. To test the hypothesis that the sphere came from a space vehicle, an analysis was made of the likely reentry history of the sphere during decay from circular orbit. The sphere originated from a U.S. space vehicle in orbit and survived reentry whether or not it was shielded by additional material burnt or melted off during reentry. Further analysis is indicated to decide whether or not this particular sphere was in fact shielded during part of the reentry. Author

N64-20665* National Aeronautics and Space Administration, Washington, D.C.
MANNED LUNAR SCIENTIFIC OPERATIONS
Paul Lowman and Donald A. Beattie N.Y., Am. Astronautical Soc. 1964 27 p refs Presented at the 10th Ann. Meeting, AAS, 4–7 May 1964
(NASA TM X-51676; AAS-Paper-64-18)

This paper outlines the major objectives, methods, and expected results of manned lunar scientific operations possible with payloads transportable by launch vehicles developed for the Apollo project. The chief scientific benefits expected from manned lunar exploration lie in the areas of comparative planetology and the study of the evolution of the solar system, and stem largely from the absence of an atmosphere and atmosphere-dependent geologic processes. Manned lunar exploration should include three main phases: (1) detailed orbital surveys, using photography, multispectral sensing, and geophysical methods; (2) surface exploration traverses, during which geological, geochemical, and geophysical investigations would be made; and (3) fixed-site, long-duration studies of the moon, including geophysical monitoring and deep drilling. After the lunar environment has been investigated by these methods, the moon might then serve as a uniquely valuable site for optical and radio astronomy, space physics, and biological studies. Author

N64-20707* International Business Machine Corp., Bethesda, Md.
SIMULATION OF GEMINI RE-ENTRY GUIDANCE Technical Report No. 1
Martin Rush and Walter Vogdes 14 Feb. 1964 67 p refs
(Contract NAS5-3486)
(NASA CR-56127)

This report presents the results of an investigation on the feasibility of simulating Gemini computer-controlled reentries with a three-degree-of-freedom program. The report includes a general description of the reentry guidance system, including the guidance computer math flow and the vehicle's response to guidance commands. A subroutine PHCAL, developed during the study to simulate the guidance system, is discussed in detail, and a FORTRAN program listing and flow chart are included. The results of a number of computer-controlled reentry simulations are also presented in detail. Author

N64-20710* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
INTERACTION OF STRUCTURAL VIBRATIONS, PROPELLANT SLOSHING AND CONTROL FOR LARGE SPACE VEHICLES
Helmut F. Bauer Stuttgart-Flughafen, Arbeits- und Forschungsgemeinschaft Graf Zeppelin [1961] 88 p refs Presented at the 51st Aeronautics Conf., Stuttgart-Flughafen, 8 Sep. 1961
In GERMAN

The control problem of large space vehicles is discussed from two aspects: (1) structural vibrations and propellant sloshing, and (2) vehicle stability. A mechanical model of propellant sloshing is presented. Simple criteria as to the effect of various control elements, as well as stability limits, for the case of flying bodies with sloshing propellants, are discussed. Also, a control-feedback stability analysis, which includes the effects of bending vibrations, propellant sloshing, and control systems, is given. I.v.L.

31 SPACE VEHICLES (LAUNCH VEHICLES)

Includes boosters; clustered rockets; and multistage rockets. *For propulsion engines see*: 27 Propulsion. *For manned space capsules, satellites, and sounding rockets and space probes see*: 32 Space Vehicles (Spacecraft). *For launch vehicle-spacecraft combinations see*: 30 Space Vehicles. *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

No abstracts in this issue.

32 SPACE VEHICLES (SPACECRAFT)

Includes manned space capsules; satellites; and sounding rockets and space probes. *For boosters and launch vehicles see*: 31 Space Vehicles (Launch Vehicles). *For launch vehicle-spacecraft combinations see*: 30 Space Vehicles. *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N64-20005* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
STEREO PHOTOGRAPHY OF THE ECHO II BALLOONS NUMBERS 9, 11, AND 13 AT LAKEHURST, NEW JERSEY
Sol H. Genatt Nov. 1963 23 p
(NASA TM X-51654; X-524-63-259) OTS: $2.60

A description is given of the equipment and technique used to determine the deviation from sphericity of the skin of three Echo II balloon satellites at varying skin pressures. Diagrams and photographs illustrate the instrumental setup and the results of the stereophotography. Author

N64-20009* General Electric Co., Philadelphia, Pa. Valley Forge Space Technology Center
FEASIBILITY STUDY OF PASSIVELY ORIENTED LENTICULAR SATELLITES Final Report, 21 Jun.-30 Aug. 1963
[1963] 153 p refs
(NASA Contract NAS5-2324)
(NASA CR-53938) OTS: $11.50 ph

The system investigated was a 267-ft-diam lens (200-ft radius of curvature) made of wire mesh material. Gravity gradient rods extending from top and bottom provide the required moments of inertia for accurate gravity gradient stabilization. A large angle, eight-degree-of-freedom, digital computer program was developed to numerically integrate the differential equations of motion. Also, a characteristic root solution to the linearized planar motion equations was programed for conducting parametric studies. Equations for the significant disturbance effects produced by solar pressure, eddy currents, and magnetic perturbations were derived, and parametric studies and weight estimates were made to provide for system parameter tradeoffs. No attempt was made in this study to solve the problems associated with balloon inflation or of structural attachment of the gravity gradient rods and damper to the balloon skin. Purely from an attitude control standpoint, the passive stabilization of the lenticular balloon to an accuracy of ±3° does appear to be feasible. Author

N64-20168 Edgerton, Germeshausen and Grier, Inc., Boston, Mass.
A SATELLITE-BORNE XENON FLASH OPTICAL BEACON FOR USE ON THE PROPOSED MISSILE RANGE CALIBRATION SATELLITE. PART I: SYSTEM DESIGN AND SPECIFICATIONS Final Report
F. T. Gronberg, R. I. Saunders, and C. Warner 23 Feb. 1964 61 p
(Contract AF 19(628)-2979)
(EG&G-B-2730; AFCRL-64-125(I); AD-438872)

A preliminary electronic and mechanical design was evolved plus a set of definitive preliminary specifications for a xenon flash system, which can be carried aboard and meet all the needs of the proposed range calibration satellite. A parallel effort revealed the savings in required energy that could result if a "tailored" beam were used giving equal illumination to all observing stations on the ground. During the final design stage in the future, advantage can eventually be taken of this proposed "tailoring" of the beacon system. The resulting optical beacon will thus both fulfill the demanding light output requirements of the stellar cameras used for range calibrations and at the same time come within the severe constraints imposed by the satellite itself as to limited available electrical energy, low permissible weight, high required reliability and rigorous launch and in-orbit environments. Author

N64-20527 Gt. Brit. Dept. of Scientific and Industrial Research, Glasgow
CATALOGUE OF DATA RECEIVED BETWEEN 1 JULY-31 DECEMBER, 1963
[1963] 18 p

This catalog contains various types of rocketry and satellite data. The data are international in scope. I.v.L.

N64-20676 American Meteorological Society, Boston, Mass.
BIBLIOGRAPHY ON METEOROLOGICAL SATELLITES (1952-1962) Supplement No. 1
Elemer Kiss, comp. Sep. 1963 55 p refs Suppl. to N64-14260 06-32

This is an experimental bibliography with indexes produced by electronic computer (IBM 1401 and 7090). The subjects covered include: (1) meteorological instruments, (2) synoptic analysis, (3) atmospheric structure, composition, and density, (4) upper atmosphere, (5) ionosphere, (6) exosphere, (7) atmospheric formations and disturbances, (8) ultraviolet and infrared radiation, (9) cosmic radiation, and (10) atmospheric temperature, pressure, wind, and moisture. R.T.K.

33 STRESSES AND LOADS

Includes fatigue; vibration; flutter; and structural tests. *For thermal stress see*: 13 Heat Transfer and Thermodynamics. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 34 Structural Design.

N64-20001* Curtiss-Wright Corp., Caldwell, N.J.
INTEGRATED APPROACH TO METAL FATIGUE Interim Report No. 2, 15 Oct. 1963-15 Jan. 1964
31 Jan. 1964 11 p
(NASA Contract NAS1-3170)
(NASA CR-53632) OTS: $1.60 ph

Tabular data verifying the hypothesis of the existence of a critical dynamic crack length are presented. Also, a program for evaluating the parameters in the crack propagation formula for a single alternating stress is discussed. I.v.L.

N64-20252 Naval Air Development Center, Johnsville, Pa.
CORRELATION OF DAMAGE POTENTIAL OF DWELL AND CYCLING SINUSOIDAL VIBRATION
F. Soboleski and J. N. Tait *In* Defense Dept. Shock, Vibration and Assoc. Environ., Pt. 3 Mar. 1964 p 113–123 (See N64-20235 13-01)

This paper presents the results of a study conducted to determine whether present specifications that require sinusoidal-resonance dwell testing could be replaced by increased-time sweep cycling. Fatigue failure is used as an equivalent damage criterion. Methods are presented by which test procedure parameters may be determined. Author

N64-20254 McDonnell Aircraft Corp., St. Louis, Mo.
COMBINED HIGH TEMPERATURE-VIBRATION TEST TECHNIQUES
H. S. Bieniecki and E. Kuhl *In* Defense Dept. Shock, Vibration and Assoc. Environ., Pt. 3 Mar. 1964 p 137–140 (See N64-20235 13-01)

The development of a high-temperature-vibration test facility to accommodate specimens up to a weight of 200 lb and to temperatures of about 4,000° F is described. Test procedures are discussed, as well as the instrumentation and controls used to measure and regulate the vibration and temperature conditions. Author

N64-20258 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
A PROCEDURE FOR TRANSLATING MEASURED VIBRATION ENVIRONMENT INTO LABORATORY TESTS
K. W. Smith *In* Defense Dept. Shock, Vibration and Assoc. Environ., Pt. 3 Mar. 1964 p 159–177 refs (See N64-20235 13-01)

The purpose of this document is to present a method for deriving laboratory vibration tests from the measured environment that occurs during transport of a missile system. This derivation is a qualitative one since many of the parameters associated with the dynamic testing of structures must be assumed, and, further, approximations are necessary to derive a practical test procedure. These approximations tend to decrease the realism of the derived laboratory vibration test. Therefore, an attempt was made to point out the probable effect on test realism associated with each approximation. It is hoped that this development will provide an interim method for qualitatively specifying laboratory vibration tests until more realistic tests can be formulated. Author

N64-20259 Naval Research Lab., Washington, D.C.
MEASUREMENT OF EQUIPMENT VIBRATIONS IN THE FIELD AS A HELP FOR DETERMINING VIBRATION SPECIFICATIONS
I. Vigness *In* Defense Dept. Shock, Vibration and Assoc. Environ., Pt. 3 Mar. 1964 p 179–181 (See N64-20235 13-01)

The limitations of current methods of translating field vibration data into specifications are discussed. It is shown that in many cases an overtest may result. Several practical solutions to the problem are suggested, one of which is to make measurements of the response of structures in the field. Author

N64-20260 General Electric Co., Utica, N.Y.
DETERMINATION OF AN OPTIMUM VIBRATION ACCEPTANCE TEST
G. J. Hasslacher, III and H. L. Murray *In* Defense Dept. Shock, Vibration and Assoc. Environ., Pt. 3 Mar. 1964 p 183–188 (See N64-20235 13-01)

A method of determining an optimum vibration acceptance test specification for aerospace electronic equipment is described. Electronic equipments are subjected to repeated test sequences at given levels until failure occurs. Data thus produced will yield an acceptance level that will not fatigue the equipment. A discussion of the related statistical and reliability problem is presented. Author

N64-20262* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
SINUSOIDAL VIBRATION TESTING OF NONLINEAR SPACECRAFT STRUCTURES
W. F. Bangs *In* Defense Dept. Shock, Vibration and Assoc. Environ., Pt. 3 Mar. 1964 p 195–201 refs (See N64-20235 13-01)

The vibration testing of large spacecraft structures in accordance with procedures similar to those developed for military equipment during the 1940's has numerous shortcomings, particularly if the testing process is considered to be a duplication of an equipment's in-service vibration. The purpose of this paper is to discuss some of the shortcomings associated with the familiar sinusoidal sweep test. Waveform distortion is discussed. An analytical model of a simplified structure undergoing vibration testing was studied with the aid of an analog computer. Solutions for a nonlinear model demonstrate distortion of the armature acceleration even though the applied force is sinusoidal. Filtering the control signal to eliminate distortion may unduly penalize the specimen, although this technique is acceptable where the distortion is the random type caused by the banging of parts. Author

N64-20263 Lockheed-California Co., Burbank
SOME PROBLEM AREAS IN THE INTERPRETATION OF VIBRATION QUALIFICATION TESTS
J. E. Wignot and M. D. Lamoree *In* Defense Dept. Shock, Vibration and Assoc. Environ., Pt. 3 Mar. 1964 p 203–210 refs (See N64-20235 13-01)

Two types of problems are discussed—those concerned with the interpretation of vibration test specifications that arise in conducting the qualification tests, and those involved in the interpretation of qualification test failures as they relate to the probability of failure due to vibration in the airplane. The role of standardization of test procedures as a means of alleviating these problems is emphasized. Although the discussion is concerned exclusively with the sinusoidal qualification tests of electronic equipment for aircraft, many of the statements are applicable to vibration qualification tests in general. Author

N64-20264 Royal Armament Research and Development Establishment, Fort Halstead (Gt. Brit.)
TAMING THE GENERAL-PURPOSE VIBRATION TEST
J. P. Salter *In* Defense Dept. Shock, Vibration and Assoc. Environ., Pt. 3 Mar. 1964 p 211–217 refs (See N64-20235 13-01)

There is little doubt that the acceleration levels quoted in many of the general purpose vibration test specifications issued by official agencies are based upon measurements made at vibration antinodes. Where this is so, there is no justification for permitting the acceleration level at any of the attachment points to exceed the level quoted, or for permitting the

applied force to exceed a computable value. An extension of the control system results in a more rational test. Two aspects of such a test are considered here, each capable of modest improvement. The first is that in maintaining the specified acceleration level at the point of attachment that happens to carry the control accelerometer may be generating a higher level of acceleration at the remaining points of attachment. The second is that in maintaining the specified acceleration level, regardless of the dynamic reactions of the article under test, the article is being treated as if, in service use, it will be attached to a structure of infinite mechanical impedance, rather than to a structure whose impedance will seldom be greater than that of the article itself. The test can be improved by employing multipoint rather than single-point acceleration control and by setting an appropriate limit to the force brought to bear on the test article. Author

N64-20285 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
COMPARISONS OF SOME WING FLUTTER CHARACTERISTICS OBTAINED BY MODIFIED STRIP ANALYSIS, SUBSONIC KERNEL FUNCTION, AND EXPERIMENT
E. Carson Yates, Jr., and Robert N. Desmarais Washington, NASA, May 1964 52 p refs
(NASA TN D-2297) OTS: $1.25

Subsonic flutter characteristics for 7 swept and unswept wings were calculated by the kernel-function method and by a modified strip method. Comparisons of the results from the approximate strip method, from the more rigorous lifting-surface method, and from flutter experiments indicated that all calculated flutter speeds were in good agreement with measured values, with the exception of those given by the kernel-function method for two swept wings that had ballast weight distributed along leading or trailing edges. The latter results were unconservative over most of the subsonic range and, within the limits of this investigation, were not significantly improved by changes in the number or type of vibration modes (coupled or uncoupled) nor by increasing the number of downwash collocation points. No appreciable changes were encountered in kernel-function results when uncoupled (rather than coupled) vibration modes were employed for homogeneous wings whose natural modes involved a high degree of bending-torsion coupling. Author

N64-20330 Polytechnic Inst. of Brooklyn, N.Y.
CREEP ANALYSIS OF CIRCULAR CYLINDRICAL SHELLS
F. A. Cozzarelli, Sharad A. Patel, and B. Venkatraman Apr. 1964 21 p refs
(Contract Nonr-839(23))
(PIBAL-685; AD-436264)

Governing equations for nonlinear creep analysis of thin circular cylindrical shells are derived based upon a power law for creep. These equations are solved for a clamped shell subjected to uniform internal pressure. The method of solution is one of iteration in which the starting solution is that for the linear case. Stress resultants and deflections are presented for various values of the parameters involved. Author

N64-20350 Stanford U., Calif.
AXISYMMETRICAL CREEP BUCKLING OF CLAMPED SHALLOW SPHERICAL SHELLS Contract Report No. 2
N. C. Huang Dec. 1963 32 p refs
(Contract Nonr 225(69))
(TR-145; AD-436288) OTS: $3.60

The effect of viscoelastic properties of shells on the axisymmetrical buckling is considered in this paper. Under constant uniform pressure, viscoelastic shells exhibit an increase of average vertical deflection with time. The crucial point studied here is the time factor for different pressures and for shells with different geometrical parameters. The viscoelastic material used was polymethylmethacrylate. The relaxation of external pressure by an incompressible fluid is analyzed. Critical times under different pressures are tabulated. A.W.

N64-20369 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
NON-STEADY FLUTTER OF PLATES AND SLANTED SHELLS IN GAS FLOWS
V. V. Bolotin *In its* News of the Academy of Sci. of the USSR 22 Apr. 1963 p 12–26 refs (See N64-20367 13-01)

The problem of the unsteady flutter of plates and slanted shells in supersonic gas streams is examined. The examination is based on equations that were obtained in previous papers and later were applied to a number of steady problems regarding oscillations and thermal buckling. The present article deals with finding nonsteady solutions for the simultaneous variation of stream velocity, ambient medium density, and plate or shell temperature. For this an approximate method for investigation of nonsteady processes in linear systems with many degrees of freedom, referred to as the "method of single-frequency oscillations," is employed. An example is given of a determination of the amplitudes of nonsteady flutter for a flat panel. Author

N64-20383 Pratt and Whitney Aircraft, East Hartford, Conn.
RESEARCH AND DEVELOPMENT OF TITANIUM ROCKET MOTOR CASE Quarterly Report No. 12, 1 Apr.-30 Jun. 1963
H. A. Hauser and W. E. Helfrich 30 Jul. 1963 117 p
(Contract DA-19-020-ORD-5230)
(WAL-TR-766-2/1-13; PWA-2254; AD-428244)

Research and development of a high strength, lightweight titanium alloy rocket case are reported. Included are: (1) final results of notched ($K_t = 8$) sustained-load tests conducted on flow-turned material with hydrogen contents of 70 and 200 ppm; (2) results of investigation of hot-rolling using resistance seam welding equipment as a stress-relieving technique for B-120 VCA titanium alloy weldments; (3) evaluation, including mechanical property testing, of full-scale front dome burst-test assembly after hydrostatic testing to destruction; (4) effects of severe cold-working on the 975F aging properties of Ti-15 Mo alloy; and (5) fracture toughness properties of Ti-15 Mo alloy at various yield strength levels. Author

N64-20434 National Aero- and Astronautical Research Inst., Amsterdam (Netherlands)
COMPARISON BETWEEN THE STRESS DISTRIBUTIONS IN TWO SWEPT-BACK WINGS, ONE WITH RIBS IN FLIGHT DIRECTION, AND ONE WITH RIBS PERPENDICULAR TO THE SPARS
R. M. Lichtveld 25 Sep. 1963 63 p
(Sponsored by Netherlands Aircraft Develop. Board)
(NRL-TM-S.600)

A 45° swept-back box beam with a nonswept center part and all ribs perpendicular to the spars is analyzed by application of the principle of minimum complementary energy. Thirty-one supplementary stress systems of six different types are used. The entire computation has been effected by a systematic matrix procedure. Two structures are considered, differing in the stiffness of the first rib in the swept part. The stress distributions are compared with that in a similar box beam, with the same dimensions and weight, but with the ribs in flight direction. The accuracy of the computations appears to be insufficient to allow a conclusion as to the

most efficient structural form. However, there are some indications (shearflows in the webs) that a box beam with ribs perpendicular to the spars has somewhat smaller stress concentrations in the region of the rear spar. Author

N64-20435 National Aero- and Astronautical Research Inst., Amsterdam (Netherlands)
RESULTS OF STRAIN MEASUREMENTS PERFORMED ON A POLYSTYRENE SWEPT BACK BOX BEAM WITH A NON SWEPT-CENTER PART, AND THEIR COMPARISON WITH THEORETICAL RESULTS
R. M. Lichtveld and P. J. Sevenhuysen Jan. 1963 30 p refs
(NLR-TR-S.597)

Strain gage measurements were made on a polystyrene swept-back box beam. Three symmetrical cases and one antisymmetrical loading case were investigated. In order to minimize the influence of viscoelastic behavior, use was made of a constant-displacement method in loading the test specimen. The results are compared with theoretical results derived previously by means of the principle of minimum complementary energy. Good agreement between test and theoretical results is found. For 2 of the 4 loading cases investigated, the comparison showed some differences in the region of high-stress concentration. Author

N64-20458 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
STRESS CALCULATION IN AN OPEN CYLINDRICAL SHELL SUBJECTED TO THE ACTION OF CENTRIFUGAL FORCES
Szczepan Borokowski 10 Apr. 1964 42 p refs Transl. into ENGLISH from Rozprawy Inzynierskie (Poland), v. 10, no. 3, 1962 p 459–496
(RSIC-155; AD-438015)

Solution of the problem of discontinuity stresses in an open cylindrical shell formed by two rotary-cylindrical shells of different curvature radii, and loaded by centrifugal forces, is considered. In particular, blades possessing a contour formed by two radii are treated as cylindrical shells reduced by a section to two rotary-cylindrical shells. Fundamental equations and formulas of the rotary-cylindrical shell theory are presented along with fundamental formulas for the first shell. Numerical examples, using the proposed solutions, are presented. P.V.E.

N64-20532 Lockheed Missiles and Space Co., Sunnyvale, Calif.
DYNAMIC LOADING AND STRUCTURES ANALYSIS: AN ANNOTATED BIBLIOGRAPHY
Jack B. Goldmann and Helen Mc Cormick, comp. Jul. 1963 158 p refs
(SB-63-53; Rept.-5-73-63-9)

This bibliography emphasizes structural testing of loading methods, equipment used, and results obtained in the aerospace industry within the last 3 to 5 years. Categories surveyed include dynamic loading, shell structures, test applications, test facilities, test instrumentation, and transducers. Author

N64-20570 New York U., N. Y. Courant Inst. of Mathematical Sciences
STRESSES IN A PERFORATED CYLINDRICAL SHELL
Frances Bauer and Edward L. Reiss Feb. 1964 33 p refs
(Contracts Nonr-285(42); AT(30-1)-1480)
(IMM-NYU-320; AD-434560)

It is assumed that the deformations of a thin cylindrical elastic shell, subjected to a uniform lateral pressure, are adequately described by the Donnell shell equations. The surface of the shell is perforated by a rectangular cutout. The tangential membrane displacements and the normal membrane stresses vanish on the simply supported edges of the hole and on the ends of the cylinder. Numerical solutions are obtained by replacing the boundary value problem by a finite difference approximation and solving the resulting system of linear algebraic equations with an iteration procedure. Author

N64-20638 Syracuse U., N.Y.
PRINCIPLE OF STATIONARY COMPLEMENTARY ENERGY FOR STRUCTURES WITH FINITE DEFORMATIONS
C. Libove (Ph.D. Thesis) Apr. 1962 164 p refs
(NSF Grant 14645)
(ME-836-624)

A new principle of stationary complementary energy is developed for structures with finite displacements, rotations, or strains, made of material with linear or nonlinear elasticity. The loading may consist of prescribed forces or prescribed displacements. The starting point for the development of the principle is a vectorial definition of complementary work, analogous to the vectorial definition of ordinary work, and a definition of complementary energy in terms of complementary work analogous to the definition of potential energy in terms of ordinary work. To demonstrate the applicability of the new principle, it is used to analyze several trusses and a beam with large deflections and to solve several column-buckling problems. The new principle reduces to the conventional one when the deformations are assumed to be infinitesimal. Author

N64-20675 Chicago Bridge and Iron Co., Ill. General Engineering Dept.
CIRCUMFERENTIAL STRESSES IN PRESSURE VESSEL SHELLS OF REVOLUTION
L. P. Zick and A. R. St. Germain Repr. from Trans. of the ASME, J. of Eng. for Ind. 16 p refs Presented at the Petrol. Mech. Eng. Conf., Dallas, 23–26 Sep. 1962
(ASME-PAPER-62-PET-4)

Simple concepts that can be used to closely approximate the circumferential stress at any point in a given shell of revolution are developed. A visual picture, in the form of diagrams, of the stresses and deflections of pressure vessel shells of revolution, including various head-to-shell junctions, reducer sections, and cylindrical openings at the pole of a spherical segment, is presented. R.T.K.

34 STRUCTURAL DESIGN

Includes structural elements; and weight analysis. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 33 Stresses and Loads.

N64-20010 Weapons Research Establishment (Australia)
DESIGN CURVES FOR METAL PLATE PHASE SHIFTERS IN CYLINDRICAL WAVEGUIDE (H_{11} MODE) FROM AN ANALYSIS USING A DIGITAL COMPUTER
J. R. Pyle and R. J. Angley Nov. 1963 43 p refs
(WRE-TN-PAD-78)

Design curves for metal plate phase shifters in 10 sizes of cylindrical waveguide carrying the H_{11} (TE_{11}) mode were obtained from an analysis using an IBM-7090 digital computer. The curves may be used for the design of "quarter-wave plates" to produce circularly polarized electromagnetic

fields in the frequency range 3.85 kmc/s to 90.0 kmc/s. The differential phase shift caused by the metal plates is determined from two cutoff wavelengths. Curves of computed differential phase shift were compared with experimentally determined curves for two sizes of cylindrical waveguide and plates in X band. It was found that computed and experimental data agreed to within 0.2°/in., this being the maximum deviation of any experimental point about the computed curve. Author

N64-20059 General Dynamics/Fort Worth, Tex.
"K" FACTOR DETERMINATION OF FOUR TYPES OF PANEL CONSTRUCTION IN F-111 AIRPLANE
15 Apr. 1964 8 p
(Contract AF 33(657)-11214)
(FTDM-3174; AD-438470)

Tests were conducted to determine the thermal conductivity (K) of panels designed to insulate certain areas of the F-111 airplane fuel tank. Type I (all fiber glass) panels exhibited the lowest K factors of all panels at mean temperatures below 300° F. Type II (composite fiber glass–metal) panels, a 1/8-in. 3.1-lb OX HRP Core reduced by about 25% the values of the control stainless steel panel. Type III (aluminum skin–fiber glass core) panel exhibited a steep slope when K was plotted against temperature. The values ranged from 0.58 at 167° F mean temperature to 1.19 at 345° F. Type IV panels (microglass balloon-filled Q 94-003 sealant) showed negative slope when K was plotted against temperature. This is not characteristic of thermal conductivity curves. Higher glass concentrations of the coating result in lower K factors. Author

N64-20062 General Dynamics/Fort Worth, Tex.
ADHESIVE SCREENING TESTS FOR CENTAUR LIGHTWEIGHT THERMAL BLANKETS
J. E. Thomas 15 Apr. 1964 20 p
(Contract AF 33(657)-11214)
(FTDM-3194; AD-438473)

Materials for Centaur lightweight-insulation blanket assemblies are basically glass-reinforced laminate facings bonded with an adhesive-to-glass-reinforced plastic honeycomb core filled with a low-density insulating foam and must be capable of withstanding maximum stresses and rapid aerodynamic heating during the launch phase of flight. Five adhesives, HT424, Aerobond 422, AF-130, Narmco 306 and 408, were selected for tests in bonded sandwich panels. Flatwise tension tests at −320° F, RT, and +350° F were conducted as screening tests for the various adhesives and sandwich components. Results show that three adhesives, Aerobond 422, HT424, and Narmco 306, are capable of producing satisfactory strength results whereas two adhesives, Narmco 408 and AF-130 strength results were unsatisfactory. Author

N64-20179 Brunswick Corp., Marion, Va. Defense Products Div.
DEVELOPMENT OF A 1200°F RADOME Interim Engineering Report No. 4, 1 Jan.-31 Mar. 1964
V. A. Chase and R. L. Copeland [1964] 67 p
(Contract AF 33(657)-11469)
(AD-438134)

Investigation of the effect of thermal expansion differences between the matrix and reinforcement on strength retention of glass reinforced aluminum phosphate laminates after thermal aging is discussed. New matrices were compounded and evaluated for mechanical, physical, and thermal properties. Laminates were prepared from these matrices and tested at ambient temperature before and after thermal aging. The data indicated that the proper matching of thermal expansion for the matrix and reinforcement is necessary for maintaining high strength after thermal aging. Insertion phase delay was measured on a radome panel at 10.0 Gc for different angles of incidence. A radome approximately 64 in. in height has been designed and fabricated from the reinforced aluminum phosphate material. A discussion of the fabrication methods developed is given. Problem areas, conclusions, and recommendations are presented. Author

N64-20180 Goodyear Aerospace Corp., Akron, Ohio
STUDY OF THE EFFECTS OF MECHANICAL DAMAGE ON THE PERFORMANCE OF FILAMENT-WOUND MOTOR CASES Progress Report No. 6, 1 Feb.-31 Mar. 1964
R. A. Burkley, T. J. Boller, and I. R. Butcher 20 Apr. 1964 39 p refs
(Contract NOw-63-0449-c(FBM))
(GER-11154 S/5; AD-438195)

A study is presented of the vulnerability of filament-wound motor cases to mechanical damage. The program is divided into two parts: (1) the correlation of failure stress as a function of flaw depth in Polaris-type cases and (2) the determination of means of making depot repairs on damaged cases. One of the purposes of the program was to establish by experimental tests what correlation can be realistically derived for failure stress as a function of flaw depth for motor cases of the thickness of Polaris A-3 first-stage and second-stage cases and to determine the effects of winding sequence on the ability to resist failure from surface flaws. Some correlations are presented. The other objective of the program was to establish means of making depot repairs on damaged cases and to determine the reliability and ease of performing various repair techniques; recommendations are given.
Author

N64-20249 Radio Corp., of America, New York, N.Y.
PROBLEMS AND CONSIDERATIONS IN COMBINING SINE AND RANDOM VIBRATION IN THE ENVIRONMENTAL TEST LABORATORY
A. R. Pelletier *In* Defense Dept. Shock, Vibration and Assoc. Environ., Pt. 3 Mar. 1964 p 101–106 (See N64-20235 13-10)

Four basic conditions or requirements are considered when sweeping sine and random signals are combined into one vibration test environment. Each of the four conditions is discussed in detail as to problems, advantages and disadvantages, and the necessity and justifications to impose each requirement.
Author

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